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Title page	To follow frontispiece in this order.
Contents of Nos. 3 and 4 of Vol. XXXIV	
List of Contributors	
List of Plates	
Index to Illustrations	
Errata	
List of Office Bearers, Life Members and Members	
Index to Species	To go at the end of two numbers.

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CONTENTS OF VOLUME XXXIV.

No. 3

PAGE

THE GAME BIRDS OF THE INDIAN EMPIRE. Part XII. (*With a coloured plate*) of The Eastern Grey Plover (*Squatarola squatarola*) and The Indian Kentish Plover (*Leucopolius alexandrinus seebohmi*). By E. C. Stuart Baker, J.P., O.B.E., F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U. 613

REVISION OF THE FLORA OF THE BOMBAY PRESIDENCY. Part XIII. By Rev. E. Blatter, S.J., Ph.D., F.L.S. 623

THE LIONS OF ASIA. (*With five plates*). By R. I. Pocock, F.R.S 638

THE BIRDS OF THE PROME DISTRICT OF LOWER BURMA. (*With a map*). By J. K. Stanford, M.C., I.C.S., and Dr. Claud B. Ticehurst, M.D., M.A., M.B.O.U., F.R.G.S 666

THE PANTHER AS I HAVE KNOWN HIM. Part III. (*With a plate*). By Lt.-Col. A. H. E. Mosse, I.A., F.Z.S 673

ABNORMAL TUSKS OF ELEPHANTS. (*With six plates*). By Sir Frank Colyer, K.B.E., F.R.C.S 694

FISHING IN THE RIVERS OF C. P. (*With three text-figures*). By Major W. B. Trevenen 700

SOME BEAUTIFUL INDIAN TREES. Part V. (*With two coloured plates and two black and white plates*). By Rev. E. Blatter, S.J., Ph.D., F.L.S. and W. S. Millard, F.Z.S 716

THE STUDY OF INDIAN BIRDS. Part VI. (*With a plate and two text-figures*). By H. Whistler, F.Z.S., M.B.O.U 720

THE MALARIAL PROBLEM IN BOMBAY. (*With a map*). By Major G. Covell, M.D., D.Ph., D.T.M. and H., I.M.S 736

THE ORNITHOLOGICAL STATION IN HELIGOLAND. (*With four plates and a Diagram*). By Salim A. Ali, M.B.O.U 743

A NEW INDIAN DRAGONFLY. (*With two text-figures*). By Lt.-Col. F. C. Fraser, I.M.S., F.E.S 752

THE ORIGIN OF CONTINENTS AND OCEANS. (*With one plate and five Diagrams*). By W. E. Wait, M.A., F.Z.S 754

ON THE NESTING OF THE CRESTED SWIFTS. (*With two plates*). By H. Whistler, M.B.O.U., F.Z.S 772

PAGE
THE STINGING CATERPILLAR. (*With five text-figures*). By Major R. W. G. Hingston, I.M.S. 778
THE TOXICITY OF THE VENOM OF INDIAN SCORPIONS. By Rev. J. F. Caius, S.J., F.L.S. 788

REVIEWS:—

1. SYSTEMA AVIUM ÆTHIOPICARUE. PART II ... 790
2. HANDBOOK OF THE BIRDS OF WEST AFRICA ... 791
3. THE MOTOR MECHANISM OF PLANTS 791
4. LEHRBUCH DER ALLGEMEINEN PFLANZENGEOGRAPHIE 793
5. PLANT STUDIES 794
6. ZOOLOGY 794
7. GENERAL BOTANY 795

MISCELLANEOUS NOTES—

I. Three Tigers at a kill. (*With a photo*). By Major C. Swire 796
II. Panther climbing up to a machan. By R. C. Morris 797
III. A Panther incident. By G. de L'Isle Sturm...... 798
IV. Note on the Malay Bear (*Ursus malayanus*). (*With a photo*). By Major E. G. Phythian-Adams ... 798
V. Sounds made by Porcupines. By R. C. Morris ... 799
VI. Observations on the Indian Elephant. By R. C. Morris 800
VII. On distinguishing between males and females and other controversial matters pertaining to the Gaur. *Bibos gaurus*. By R. C. Morris............ 801
VIII. Vigils at waterholes. By Lieut. A. Bayley-de-Castro, I.M.D. 802
IX. The heart-shot in game. By R. C. Morris......... 804
X. The Common Mynah (*A. tristis*) as a pest in Seychelles. By P. R. Dupont 806
XI. On the occurrence of the Grey-backed Shrike (*Lanius tephronotus*, Vigors) in the suburbs of Calcutta. By M. N. Acharjie 807
XII. Breeding of the Great Stone-Plover (*Œdicnemus recurvirostris*). By C. G. Chevenix Trench ... 809
XIII. Occurrence of the Tufted Pochard (*Nyroca fuligula*) in Gilgit. By Capt. M. H. Berkeley 809

PAGE

XIV. First Indian Record of the Eastern Grey Duck (*Anas pœcilorhyncha zonorhyncha*, Swinhoe) and the occurrence of the Eastern White-eye (*Nyroca rufa bœri* Radde) in Behar. By C. M. Inglis, F.Z.S., M.B.O.U. ... 810

XV. Migration Notes from Kohat, N.-W.F.P. By Lt.-Col. G. de la P. Beresford ... 810

XVI. Birds of a Himalayan Torrent—a study in Behaviour. By Major R. W. G. Hingston, I.M.S. ... 811

XVII. Birds seen on a trip from Pottuvil to Kumna, Ceylon. By George Brown ... 815

XVIII. A list of some Birds of the Seven Hills of Naini Tal, U.P. By Major General Corrie Hudson ... 821

XIX. Notes on the Star Tortoise (*Testudo elegans*). By R. Shunker Narayan Pillay ... 828

XX. Capturing Monitor Lizards and Pythons. By Frank C. Riches ... 828

XXI. Masheer-fishing in Burma. By Captain S. C. Macgregor ... 829

XXII. Ant-mimicking Spiders as victims of Wasps. (*With a photo*). By K. Kunhi Kannan ... 831

XXIII. A freak *Papilio polytes romulus* Cr. ♀ (*With a plate*). By O. C. Ollenbach ... 832

XXIV. Notes on *Parantirrhœa marshalli* and *Prioneris sita*. By J. A. Yates ... 833

XXV. Notes on *Appias libythea libythea*. ♀. By J. A. Yates. 834

XXVI. On the peculiar cross-vein-like structures in the hind-wings of *Croce filipennis*, Westw., ♂ (*Nemopteridæ*). (*With three micro photographs*). By S. Mukerjee ... 834

XXVII. Butterfly-collecting grounds at Mussooree (U. P.) By O. C. Ollenbach ... 836

XXVIII. On the true nature of the Nuclear divisions in old internodes of local *Tradescentia* stems. (*With a plate*). By Prof. S. R. Bose ... 840

XXIX. On the occurrence of the Vegetative buds on the root of Gram. (*With a text-figure*). By T. C. N. Singh ... 841

XXX. An instance of anomalous branching of the conjugation-tubes of an Indian form of *Spirogyra neglecta* (Hass) Kuetz. (*With a plate*). By Kanti Gopal Banerjee ... 842

PAGE

XXXI. Some Liverworts of the order *Marchantiales* from Burma. By L. P. Khanna........................... 844
XXXII. Notes on Broomcorn with five brushes. By S. S. Nehru, M.A., Ph.D., I.C.S................................ 847
XXXIII. Cultivation of Broomcorn in India. By S. S. Nehru, M.A., Ph.D., I.C.S................................ 847

PROCEEDINGS.. 850

CONTRIBUTIONS TO THE MUSEUM FROM JANUARY 1 TO SEPTEMBER 30, 1930.. 855

No. 4

THE GAME BIRDS OF THE INDIAN EMPIRE. Part XIII. (*With a coloured plate*) of The Chinese Oyster-catcher (*Hæmatopus ostralegus osculans*) and The Indian or Jerdons Little Ringed Plover (*Charadrius dubius jerdoni*). By E. C. Stuart Baker, J.P., O.B.E., F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.. 859
THE REVISION OF THE FLORA OF THE BOMBAY PRESIDENCY. Part XIV. By Rev. E. Blatter, S.J., Ph.D., F.L.S.......... 877
THE BIRDS OF THE PROME DISTRICT OF LOWER BURMA. Part II. By J. K. Stanford, I.C.S., and Dr. Claud B. Ticehurst, M.D., M.A., M.B.O.U., F.R.G.S.................... 901
PROPOSED CLASSIFICATION OF THE SMALLER INDIAN FIELD (*or Jungle-*) MICE. By T. B. Fry, I.F.S. (Retd.)............ 916
SOME BIRDS FROM THE NORTH-WEST CORNER OF FARS, PERSIA. (*With a map*). By E. C. Capito.................... 922
A NEW CEROPEGIA FROM THE WESTERN GHATS. (*With a plate*). By Rev. E. Blatter, S.J., Ph.D., F.L.S., and C. McCann, F.L.S.. 936
NOTES ON SOME RATS DAMAGING CROPS IN SOUTH INDIA. By P. N. Krishna Ayyar, B.A.................................. 937
THE NESTING HABITS OF THE BAYA (*Ploceus philippinus*). (*With 7 plates and 11 text-figures*). By Salim A. Ali, M.B.O.U.. 947
INDIAN DRAGONFLIES. Part XXXVI. (*With 7 text-figures*). By Col. F. C. Fraser, I.M.S., F.E.S............................ 965
THE FISH-SUPPLY OF THE WEST COAST OF INDIA. By Sir Reginald Spence, Kt., M.L.C., F.Z.S., and S. H. Prater, C.M.Z.S., M.L.C.. 973

PAGE

FLOWERLESS PLANTS. Part V. (*With 7 plates*). By Mrs. M. Robinson, B.A. 992
THE BUTTERFLIES OF COORG. Part I. By J. A. YATES....... 1003
THE PANTHER AS I HAVE KNOWN HIM. Part IV. By Lt.-Col. A. H. E. Mosse, I.A., F.Z.S. 1015
THE BULBULS OF THE NILGIRIS. By Capt. F. N. Betts...... 1024
NOTES ON INDIAN *Thysanoptera* WITH BRIEF DESCRIPTIONS OF NEW SPECIES. (*With two plates and a text-figure*). By T. V. Ramakrishna Ayyar, B.A., Ph.D., F.Z.S., and V. Margabandhu, M.A. 1029
THE NATURAL HISTORY OF *Calotes versicolor* (Boulenger), THE COMMON BLOOD-SUCKER. By J. J. Asana.......... 1041
EDITORIAL.......... 1048
THE TOXICITY OF THE VENOMS OF INDIAN SCORPIONS. By Fr. J. F. Caius, S.J. 1051

MISCELLANEOUS NOTES—

I. Wanted Bears. By R. J. Pocock, F.R.S. 1052
II. On the F~~oot~~ood of the Vampire Bat (*Megaderma lyra*). By Lt.-Col. A. H. E. Mosse, I.A. 1052
III. The Stripe-necked Mungoose (*Herpestes vitticollis*). By Major E. G. Pythian-Adams, I.A. (Retd.) ... 1054
IV. The Indian Wild Dog (*Cuon dukhunensis*). By R. C. Morris.......... 1054
V. Measurements of a large Indian Wolf (*Canis pallipes*). By Private Secretary to the Heir-Apparent of Dewas SR. 1055
VI. Courage and Cowardice of the Hyæna. By Major C. W. Sanders.......... 1055
VII. Measurements of Big Game. By Lt.-Col. C. H. Stockley.......... 1056
VIII. Drumming sound made by Leopards. By T. R. Livesey.......... 1056
IX. Malformation in Skull of a Thar (*Hermitragus jemlaicus*). (*With a photograph*). By Lt. R. K. M. Battye.......... 1057
X. Abnormal horns of Sambhur. (*With a photo*). By Lt.-Col. R. W. Burton, I.A. (Retd.).......... 1058
XI. A variety of the Thamin or Brow-Antlered Deer. (*Rucervus thamin*). By Lt.-Col. R. W. Burton, I.A. (Retd.).......... 1059

PAGE

XII. Swamp Deer. (*Cervus duvaucelli*) Head with Nineteen points. (*With a photo*). By R. Powell... 1060

XIII. The Occurrence of the Grey Hypocolius (*Hypocolius ampelinus*) in North Konkan. By Salim A. Ali 1061

XIV. Courtship of the Scarlet Minivet. (*Pericrocotus speciosus*). By C. McCann........................ 1061

XV. Description of and Notes on the female Chestnut-mantled Koklas (*Pucrasia m. castanea*) from Chitral. By V. S. La Personne..................... 1062

XVI. Casualties among the Eggs and Young of small Birds. By Salim A. Ali.......................... 1062

XVII. The Origin of Mimicry in Cuckoo's eggs. By Salim A. Ali.. 1067

XVIII. Notes on the Pied Crested Cuckoo (*Clamator jacobinus*) in Alibag Taluka. By Salim A. Ali...... 1071

XIX. Birds observed in the neighbourhood of Ranikhet. By F. S. Briggs................................. 1072

XX. Hovering flight of Birds and No Wind. By H. A. Allard.. 1079

XXI. Pelicans and Turtles. By D. S. Laud.................. 1081

XXII. Little Indian Grebes or Dabchicks (*Podiceps albipennis*) mobbing a snake. By Lt.-Col. C. C. Hickie.. 1081

XXIII. Cannibalism in the Indian Cobra. By Beni Charan Mahendra.. 1082

XXIV. Unusual size attained by the common Krait. (*Bungarus cæruleus*). By Capt. F. J. Rimell......... 1083

XXV. An unusually large Shaw's Rat Snake (*Zamenis fasciolatus*). By Lt.-Col. K. G. Gharpurey, I.M.S. 1084

XXVI. Snakes of Nasik. By Lt.-Col. K. G. Gharpurey, I.M.S.. 1085

XXVII. Occurrence of *Charasia dorsalis* outside the Mysore Plateau. By S. G. Manavala Ramanujan.......... 1086

XXVIII. Some Measurements of the Estuary Crocodile (*Crocodilus porosus*) from Sarawak. By E. Banks. 1086

XXIX. The Ways of Fishing Shikaris. By Col. A.E. Mahon 1088

XXX. A Leaf-mining Moth. By Dr. G. R. Tambe, M.A., B.SC., L.M. & S.. 1091

XXXI. Specific identity of the Butterflies (*Terias venata* and *T. læta*. By Lt.-Col. A. H. E. Mosse, I.A. 1094

XXXII. The Grasshopper (*Isopera pedunculata*). By Major R. W. G. Hingston, I.M.S.............................. 1095

PAGE

XXXIII. A live Beetle in the external auditory meatus of the human ear. By Lt.-Col. A. G. Tresidder, C.I.E., I.M.S. 1096
XXXIV. The effects of a bite of a Centipede (*Scolopendra* sp.). By C. McCann........ 1097
XXXV. A Centipede after its Moult (*Scolopendra* sp.). By C. McCann........ 1097
XXXVI. Some Notes on the Flowering of Bamboos. By Rev. E. Blatter, S.J........ 1097
XXXVII. On the Flowering of Bamboos. By N. E. Perry, I.C.S........ 1099
XXXVIII. The Fern-Palm. (*With a photo*). By D. S. Laud 1101
XXXIX. An abnormal fruit of *Dipterocarpus tuberculatus* Roxb. By L. P. Khanna, M.Sc., F.I.S........ 1102
PROCEEDINGS........ 1103

ALPHABETICAL LIST OF CONTRIBUTORS

VOLUME XXXIV

Nos. 3 and 4

PAGE

ACHARJIE, M. N.; On the occurrence of the Grey-backed Shrike (*Lanius tephronotus*, Vigors) in the suburbs of Calcutta 807

ALLARD, H.A.; Hovering flight of birds and no wind ... 1079

ALI, SALIM A., M.B.O.U.; The Ornithological Station at Heligoland (*with four plates and one diagram*) ... 743

———————; The nesting habits of the Baya (*Ploceus philippinus*) *with seven plates & eleven text-figures* 947

———————; The occurrence of the Grey Hypocolius (*Hypocolius ampelinus*) in North Konkan 1061

———————; Casualties among the eggs and young of small birds 1062

———————; The Origin of mimicry in Cuckoo Eggs... 1067

———————; Notes on the Pied Crested Cuckoo (*Clamator jacobinus*) in Alibag Taluka (Kolaba District) ... 1071

ASANA, J. J.; The Natural History of *Calotes versicolor*) (Boulenger). The Common Blood-sucker 1041

AYYAR, P. N. KRISHNA, B.A.; Notes on some Rats damaging crops in South India ... 937

AYYAR, T. V. RAMAKRISHNA, B.A., Ph.D., F.Z.S. and V. MARGABANDHU, M.A. Notes on Indian *Thysanoptera* with brief descriptions of new species (*with two plates and a text-figure*) 1029

PAGE

BAKER, E. C. STUART, J. P., O.B.E., F.Z.S., F.L.S., M.B.O.U., H. F. A. O. U.; The Game Birds of the Indian Empire, vol. v., Part xii (*with a coloured plate* of The Eastern Grey Plover, *Squatarola squatarola hypomela* and The Indian Kentish Plover *Leucopolus alexandrinus seebohmi*) 613

Part xiii (*with a coloured plate* of The Chinese Oyster-catcher *Hæmatopus ostralegus osculans* and The Indian, or Jerdon's Little Ringed-Plover *Charadrius dubius jerdoni*) ... 859

BANERJEE, KANTI GOPAL; An instance of anomalous branching of the conjugation-tubes of an Indian form of *Spirogyra neglecta* (Hass) Kuetz 842

BANKS, E.; Some measurements of the Estuary Crocodile (*Crocodilus porosus*) from Sarawak 1086

BATTYE, LIEUT. R. K. M.; Malformation in Skull of a Thar (*Hermitragus jemlaicus*) (*with a photo*) 1057

BAYLEY-DE-CASTRO, LIEUT. A., I.M.D.; Vigils at water-holes 802

BERESFORD, LT.-COL. G. DE LA; Migration notes from Kohat, N.-W.F.P. ... 810

Page

Berkeley, Capt. M.H.; Occurrence of the Tufted Pochard (*Nyroca fuligula*) in Gilgit 809

Betts, F. N.; The Bulbuls of the Nilghiris (*with 2 plates*). 1024

Blatter, E., S. J., Ph. D., F.L.S.; Revision of the Flora of the Bombay Presidency
Part xiii (*Elatinaceæ*) ... 623
Part xiv (*Sterculiaceæ*) ... 877

——— ———; Some notes on the flowering of Bamboos 1097

———;Ph.D. and McCann, C., F.L.S.: A new *Ceropegia* from the Western Ghats (*with a plate*) ... 936

———; and Millard, W. S., F. Z. S.; Some Beautiful Indian Trees, Part v (*with two coloured plates, two black and white plates and five diagrams*) 716

Bose, S. R.; On the true nature of the nuclear divisions in old Internodes of local *Tradescantia* stems (*with a plate*) 840

Briggs, F. S.; Birds observed in the neighbourhood of Ranikhet 1072

Brown, George; Birds seen on a trip from Pottuvil to Kumna, Ceylon 815

Burton, Lt.-Col. R. W., I.A. (Retd.); Abnormal horns of Sambhur (*Cervus unicolor*) (*with a photo*) 1058

———; A Variety of the Thamin or Brow-antlered Deer (*Rucervus thamin*) .. 1059

Caius, J. F.; S.J., F.L.S., The Toxicity of the Venom of Indian Scorpions ... 788, 1051

Capito, C. Erik, O.B.E., F.Z.S. Some Birds from the Northwest corner of Fars, Persia ... 922

Chavan, R. Y.; Measurements of a large Indian Wolf (*Canis pallipes*) 1055

Page

Colyer, Sir Frank, K. B. E., F.R.C.S.; Abnormal Tusks of Elephants (*with six plates*) 694

Covell, Major G., M. D., Ph.D., D.T.M. & H., I.M.S.; The Malaria Problem in Bombay (*with a map*) ... 736

Dupont, P. R.; The Common Mynah (*A. tristis*) as a pest in Seychelles 806

Editors, The; The Heart-shot in Game 805

Fraser, Lt.-Col. F.C., I.M.S., F.E.S.; A new Indian Dragonfly (*with two text-figures*). 752

———; Indian Dragonflies, Part xxxvi (*with seven text-figures*) ... 965

Fry, T. B., I.F.S. (Retd.); Proposed classification of the smaller Indian Field (or Jungle-) Mice 916

Gharpurey, Lt.-Col. K. G., I.M.S.; An unusually large Shaw's Rat Snake (*Zamenis fasciolatus*) 1084

———; Snakes of Nasik. 1085

Hickie, Lt.-Col. C. C.; Little Indian Grebes or Dabchicks (*Podiceps albipennis*) mobbing a snake 1081

Hingston, Major R. W. G.; The stinging Caterpillar (*Euproctis icilia*) (*with five text-figures*) 778

———; Birds of a Himalayan Torrent, a study in Behaviour 811

———; The Grasshopper (*Isoptera pedunculata*) as a Mimic of the Black ant *C. compressus* ... 1095

Hudson, Major General Corrie; A list of some Birds of the Seven Hills of Naini Tal, U. P. ... 821

Inglis, Chas. M., F. Z. S., M.B.O.U.; First Indian record of the Eastern Grey Duck (*Anas pœcilorhyncha zonorhyncha*, Swinhoe) and the

PAGE

occurrence of the Eastern white-eyed Duck (*Nyroca rufa bæri*, Radde) in Bihar 810

Kannan, K. Kunhi, Ant-mimicking Spiders as Victims of wasps (*with a photo*) ... 831

Khanna, L. P. Some Leverworts of the order *Marchantiales* from Burma 844

La Personne, V.S.; Description of and notes on the female Chestnut-mantled Koklas (*Pucrasia m. castanea*) from Chitral 1062

Laud, D. S., G. B. V. C., F.R.H.S., F.Z.S.; Pelicans and Turtles 1081

———; The Fern-Palm (*with a photo*) 1101

Livesey, T. R.; Drumming sound made by Leopards 1056

Macgregor, Capt. S. C. Masheer-Fishing in Burma 829

McCann, C.; Courtship of the Scarlet minivet (*Pericrocotus speciosus*) 1061

———; The effects of the bite of a Centipede (*Scolopendra* sp.) 1097

A Centipede (*Scolopendra* sp.) after its moult 1097

———; F.L.S. *See* Blatter, Rev. E.

Mahendra, Beni Charan; Cannibalism in the Indian Cobra 1082

Mahon, Col. A. E.; The ways of Fishing Shikaris ... 1088

Margabandhu, V., M.A.; *See* Ayyar, T.V. Ramakrishna.

Millard, W. S. *See* Blatter, Rev. E.

Morris, R. C. Panther climbing up to a machan 797

———; Sounds made by Porcupines 799

———; Observations on the Indian Elephant—Solitary Elephant 800

PAGE

Morris, R. C.; On distinguishing between males and females and other controversial matters pertaining to the Gaur (*Bibos gaurus*) 801

———; The Heart-shot in Game 804

———; The Indian wild Dog (*Cuon dukhunensis*) ... 1054

Mosse, Lt.-Col., A. H. E., I.A., F.Z.S.; The Panther as I have known him. Part 3 (*with a plate*) 672

Part 4.... ... 1015

On the Food of the Vampire Bat (*Lyroderma lyra*) ... 1052

Specific identity of the Butterflies (*Terias venata* and *T. læta*) 1094

Mukerji, S.; On the peculiar Cross-vein-like structures in the hind-wings of *Croce filipennis*, Westw. ♂ (*Nemopteridæ*) 834

Nehru, S. S., M.A., Ph. D., I.C.S.; Note on Broomcorn with five brushes ... 847

Cultivation of Broomcorn in India 847

Ollenbach, O. C.; A freak *Papilio polytes romulus* Cr. ♀ (*with a plate*) 832

———; Butterfly-collecting grounds at Mussooree (U.P.) ... 836

Parry, N. E., I.C.S.; On the flowering of Bamboos ... 1099

Phythian-Adams, Major E.G., I.A.(Retd.); Note on the Malay Bear (*Ursus malayanus*) (*with a photo*) 798

The stripe-necked Mungoose (*Herpestes vitticollis*) ... 1054

Pillay, R. Sunker Narayan; Notes on the Star Tortoise (*Testudo elegans*) ... 828

PAGE

Pocock, R. I., F.R.S.; The Lions of Asia (*with five plates and a map*) 638
——————; Wanted Bears 1052
Powell, R.; Swamp-Deer (*Rucervus duvaucelli*) head with nineteen points (*with a photo*) 1060
Prater, S. H., C.M.Z.S., M.L.C.; *See* Spence, Sir Reginald 973
Ramanujan, S. G. Manavala; Occurrence of *Charasia dorsalis* outside the Mysore Plateau 1086
Reviews:—
1. Systema avium Æthiopicarum, Part II ... 790
2. Handbook of the Birds of West Africa ... 791
3. The motor mechanism of Plants 791
4. Lehrbuch der allgemeinen Pflanzengeographie 793
5. Plant studies ... 794
6. Zoology 794
7. General Botany ... 795
Riches, Frank C.; Capturing Monitor Lizards and Pythons 828
Rimell, Capt. F. J., Unusual size attained by the Common Krait (*Bungarus cæruleus*) 1083
Robinson, Mrs. M., B.A. (T.C.D.); Flowerless Plants (*with seven plates*) ... 992
Sanders, Major C. W.; Courage and Cowardice of the Hyæna 1055
Singh, T. C. N.; On the occurrence of Vegetative Buds on the root of gram (*with a text-figure*) 841
Spence, Sir Reginald, Kt., M.L.C., F.Z.S., and Prater, S. H., C.M.Z.S., M.L.C.; The Fish-supply of the West Coast of India (*with three plates*) 973

PAGE

Stanford, J. K., M.C., I.C.S.; The Birds of the Prome District of Lower Burma with notes on the collection by C. B. Ticehurst, M.D., M.A., M.B.O.U., F.R.G.S. (*with a Map*) 666, 901
Stockley, Lt.-Col. C. H.; Measurements of Big Game... 1056
Sturm, G. de L'isle; A Panther Incident 798
Swire, Major C.; Three Tigers at a kill (*with a photo*) ... 796
Tambe, G. R., M.A., B.Sc., L.M.&S.; A Leaf-mining Moth 1091
Ticehurst, C. B.; *See* Stanford, J. K.
Trench, C. G. Chevenix; Breeding of the Great Stone-Plover (*Œdicnemus recurvirostris*) 809
Tresidder, Lt.-Col. A. G.; A live Beetle in the external auditory meatus of the human ear 1096
Trevenen, Major W. B.; Fishing in the rivers of the C. P. (*with three text-figures*) ... 700
Wait, W. E., M. A., F. Z. S.; The origin of Continents and Oceans according to the displacement theory (*with one plate and five text-figures*) ... 754
Whistler, H., F. Z. S., M. B. O. U.; The study of Indian Birds, Part VI (*with one plate and two text-figures*) 720
——————On the nesting of the Crested Swifts (*with two plates*) 772
Yates, J. A.; Notes on *Parantirrhæa marshalli* and *Prioneris sita* 833
——————Notes on *Appias libythea libythea* ♀ .. 834
——————The Butterflies of Coorg, Part I 1003

LIST OF PLATES

VOLUME XXXIV

No. 3

PAGE

The Game Birds of the Indian Empire—

Plate. The Eastern Grey Plover (*Squatarola squatarola hypomela*) and The Indian Kentish Plover (*Leucopolius alexandrinus seebohmi*) ... 613

The Lions of Asia :—

Plate I. (*A*) The Persian Lion in the Surrey Gardens described by Jardine as *Leo asiaticus*. Adapted from Lear's drawing.
(*B*) Persian Lion (Drawn from a flat skin in the British Museum) 644

Plate II. (*A*) Hurriana Lion in the Tower Menagerie described by Bennett as *Felis leo bengalensis*. Adapted from the original woodcut.
(*B*) Gujerat Lion. Drawn from Capt. Smee's skin in the British Museum 648

Plate III. Gujerat Lion presented to the Zoological Society, London, by H. H. the Maharajah Sahib of Nawanagar 655

Plate IV. Fig. *A*. (1) Facial portion of skull of Lioness from Amreli showing duplication of the infra-orbital orifice on the left side.
Fig. *A*. (2) Lateral view of skull of adult Male Lion from Amreli 657

Plate V. Fig. *B*. (1) Dorsal view of skull of adult Male Lion from Amreli.
Fig. *B*. (2) Ventral view of skull of adult Male Lion from Amreli 658

Map showing the past and present distribution of the Lion in India... 661

Map of the Birds of the Prome District of Lower Burma 667

The Panther as I have known him—

Plate (*A*) A Kathiawar Panther
(*B*) Vultures after a Meal } 680

Abnormal Tusks of Elephants—

Plate I. Fig. 1. Six tusks from the same side of a "rogue" elephant.
Fig. 2. The relations of the tusks (Fig. 1) to one another.
Fig. 3. A specimen made up of eight small tusks.
Fig. 4. A specimen showing a stage in the production of a double tusk 694

PAGE
Plate II. Fig. 5. An example of a double tusk.
Fig. 6. A tusk which has been injured at an early stage of growth.
Fig. 7. Portion of a tusk which has been injured.
Fig. 8. Section, at the position A, of the tusk shown in Fig. 7 695
Plate III. Fig. 9. Section, at the position B, of the tusk shown in Fig. 7.
Fig. 10. A tusk which has been injured.
i. General view of the tusk.
ii. View of the free end.
iii. View of the growing end 696
Plate IV. Fig. 11. Diagram of the arrangements of the tissues of the tusk shown in Fig. 10.
Fig. 12. A tusk removed from the tuskless side of an Elephant.
Fig. 13. Section through the tusk shown in Fig. 12 ... 697
Plate V. Fig. 14. A deformed tusk.
Fig. 15. A deformed tusk.
Fig. 16. Section through the tusk shown in Fig. 14 at the position marked I 698
Plate VI. Fig. 17. Section through the tusk shown in Fig. 14 at the position marked II.
Fig. 18. Section through the tusk shown in Fig. 15 at the position marked in the illustration ... 699

Beautiful Indian Trees—

Plate 9. The Scarlet-Bell Tree (*Spathodea campanulata*) ... 716
Plate IX. (1) The Scarlet-Bell Tree (*S. campanulata*) Victoria Gardens, Bombay.
(2) Flowers of the Scarlet Bell Tree (*S. campanulata*) ... 717
Plate 10. The Rusty Shield-Bearer (*Peltophorum ferrugineum*) ... 718
Plate X. The Rusty Shield-Bearer (*P. ferrugineum*) Trees growing in the vicinity of the Prince of Wales Museum, Bombay. 719
Plate I. The Little Bittern (*Ixobrychus minuta*) on its nest ... 734

The Ornithological Station at Heligoland—

Plate. I. (*A*) Heligoland from the sea.
(*B*) On the Beach, Dunen Island (Heligoland in the background) 744
Plate II. (*A*) " Lange anna "—a feature of Heligoland.
(*B*) A general view of the Sapskuhle or Trapping garden, showing dense vegetation 745
Plate III. (*A*) Dr. Drost removing trapped birds from Trap No. 1.
(*B*) Dr. E. Stresemann at Trap No. 3 746
Plate IV. (*A*) Ringing in progress at the Sapskuhle.
(*B*) A ringed Sparrow-Hawk (*Accipiter nisus nisus*) ready to be released 747

The Origin of Continents and Oceans—

Plate. Fig. 1. Upper carboniferous, Fig. 2 Eocene, Fig. 3 Older Quaternary 763

PAGE

Nesting of the Crested Swifts –
Plate I. Fig. 1. The bottom of the nest ; Fig. 2. Nest and egg ; Fig. 3. A young Crested Swift in its nest, adult birds in the back-ground 772
Plate II. (*A*) The nestling in a defensive pose.
(*B*) A young Crested Swift 773
Plate. Freak example of *Papilio polytes romulus* Cr. ♀ 832
Plate. *Croce filipennis.*
Peculiar cross-vein-like structure in the hind-wings 835
Nuclear Division in old Internodes of *Tradescantia* stems.
Fig. 1. Microphotograph of a longitudinal section of the stem of *T. discolor.*
Fig. 2. Microphotograph of a longitudinal section of the stem *T. zebrina* 841
Plate. *Spirogyra neglecta.*
Branching of conjugation tubes 843

No. 4

The Game Birds of the Indian Empire—
Plate A. The Chinese Oyster-catcher (*Hæmatopus ostralegus osculans*).
Plate B. The Indian or Jerdon's Little Ringed Plover (*Charadrius dubius jerdoni* 859
A new *Ceropegia* from the Western Ghats—
Plate. *Ceropegia polyantha* sp. nov.... 936
Nesting-habits of the Baya (*Ploceus philippinus*)—
Plate I. (1) My Observation 'Hide' in position at Colony No. 1.
(2) A 'Close up' of a portion of above Colony ... 948
Plate II. (3) A cock on Nest in an early stage.
(4) A further stage in the construction 952
Plate III. (5) After weaving in his bunch of strips, the cock often perches awhile on the dome as if for breath—
(6) and joins lustily in the frequent community courses... 954
Plate IV. (7) All the builders flutter their wings and join in the choruses, in whatever position they happen to be at the time.
(8) Pilfering material from neighbouring nests is extensively practised by certain 'habitual offenders' ... 957
Plate V. (9) A cock, dissatisfied with his partly-built nest, works in dead earnest for its undoing.
(10) Sometimes two females fight for possession of an eligible nest 958
Plate VI. (11) A pair of white-throated Munias (*Uroloncha malabarica*) persistently haunted Colony No. 1, and entered and left the nests freely.
(12) When fresh building work is finally abandoned, the Cocks often occupy themselves in elongating the entrance tubes of their nests 960

Page
Plate VII. (13) Some birds alight on a neighbouring branch before flying into the nest with food for the young.
(14) A Baya shooting up the tube of its nest is a wonderful sight 963

The Fish-supply of the West Coast of India—

Plate I. (*A*) Wagli (*Trygon microps*).
(*B*) Goal (*Sciæna diacanthus*).
(*C*) Ravas (*Polynemus indicus*).
(*D*) Wam (*Murænesox talabonoides*) 976
Plate II. Tambusa *Lutianus johnii* 977
Plate III. Chand *Drepane punctata* 984

Flowerless Plants—

Plate I. Sporophytes, Rhizomes and Prothallus 992
Plate II. Ferns with the fertile fronds differing from the sterile fronds 993
Plate III. Different types of Sori 994
Plate IV. Ferns which have the upper part of frond formed entirely of the sporangia 995
Plate V. Cross section of frond of *Aspidium*, Sporangium of *Polipodium*, Sporangiums of *Lygodium*, *Gleichenia osmunda* and part of frond of *Angiopteres evecta* ... 998
Plate VI. Some Fern allies 999
Plate VII. Some more Fern allies 1000

The Bulbuls of the Nilgiris—

Plate I. (*A*) Nest of Red-Whiskered Bulbul (*Molpastes cafer cafer*).
(*B*) Red-Whiskered Bulbul on nest 1026
Plate II. (*A*) Yellow-browed Bulbul at nest (*Iole icterica*).
(*B*) Nest of Yellow-browed Bulbul (*Iole icterica*) ... 1028

India *Thysanoptera*—

Plate I. (1) *Erythrothrips asiaticus.*—Head and antennæ
(2) ,, ,, —Right fore-wing
(3) *Æolothrips pandyani.* —Head to show antennæ
(4) ,, ,, —Fore-wing
(5) *Mymarothrips garuda.* —Head with antennæ
(6) ,, ,, —Right fore-wing ... 1030
Plate II. (1) *Heliothrips kadaliphila.* —Anterior region of body
(2) ,, ,, —Right fore-wing
(3) *Dendrothrips dwivarna.* —Head to show setæ
(4) ,, ,, —Right fore-wing
(5) *Scolothrips asura.*—(*a*) Head and Prothorax (*b*) ntennæ (*c*) Fore-wing
(6) *Tryphactothrips rutherfordi* B.—Fore-part of body
(7) *Euoplothrips malabarica.*—Fore-part of body ... 1031

INDEX TO ILLUSTRATIONS

VOLUME XXXIV

Nos. 3 and 4

PAGE

Actinopteris dichotoma, Pl. figs. 5 & 6 Linear sori 994
Adiantum capillus veneris, Pl. fig. 7, Enlarged leaflet ... 994
Ælothrips pandyani, Pl. fig. 3, Head to show antennæ; fig. 4 Forewing 1030
Angiopteris evecta, Pl. figs. 8 & 9, Part of frond with synangia on under side 998
Ant-mimicking Spiders photo... 831
Aspidium, Pl. figs. 1 & 2, Part of frond 994
Aspidium, Pl. figs. 1 & 2, Cross section of frond showing sorus with *Sporangia* sp. beneath the indusium 998
Aspidium
  Pl. fig. 1. Sporophyte.
  2. Creeping rhizome
  3–4. Cross section of rhizome.
  5–7. Germination of spore producing young prothallus.
  8. Fully grown prothallus.
  9. Prothallus with young sporophyte 992
Asplenium normale, Pl. figs. 3 & 4 Oval sori 994
Bombay, Map of, showing wards and sections... 736
Botrychium daucifolium, Pl. figs. 2 & 3, Sporangia enlarged 995
Burma, Map of the Prome District 667

PAGE

Burmargiolestes melanothorax
  Fore-wing fig. 1 965
  Anal appendages fig. 2 ... 966
Ceropegia polyantha, Pl. ... 936
Cervus unicolor, Photo of abnormal horns 1058
Charadrius dubius jerdoni, Pl. fig. 2 859
Continents and Oceans, Origin of:—
  Diagram A. showing section across the Lithosphere or upper crust of the earth ... 756
  Diagram C. Hypsometric curve of the earth's surface after Krümmel 759
  Diagram D. Section through margin of continent ... 759
  Diagram E. Section through sial crust 761
  Pl. Fg. 1. Upper Carboniferous.
  2. Eocene.
  3. Older Quaternary. 763
Croce filipennis, Cross-vein-like structure in the hind-wings, Pl. 835
Cycas circinalis, Photo of male in flower 1102
Dondothrips dwivarna
  Pl. fig. 3. Head to show setæ.
  4. Right fore-wing ... 1031
Drepane punctata. Pl. ... 984
Drymoglossum pilosella, Pl. fig. 4. Fertile and sterile fronds 993
Elaphoglossum conforme, Pl. fig. 2. Fertile and sterile fronds 993

Page

Elephants, abnormal tusks of :—
  Plate I.
  Fig. 1. Six tusks from the same side of a rogue Elephant.
  Fig. 2. The relations of the tusks (fig. 1) to one another.
  Fig. 3. A specimen made up of eight small tusks.
  Fig. 4. A specimen showing a stage in the production of a double tusk 694
  Plate II
  Fig. 5. An example of a double tusk.
  Fig. 6. A tusk which has been injured at an early stage of growth.
  Fig. 7. Portion of a tusk which has been injured.
  Fig. 8. Section, at the position A, of the tusk shown in fig. 7. 695
  Plate III.
  Fig. 9. Section, at the position B, of the tusk shown in Fig. 7.
  Fig. 10. A tusk which has been injured :
    i. General view of the tusk.
    ii. View of the free end.
    iii. View of the growing end ... 696
  Plate IV.
  Fig. 11. Diagram of the arrangements of the tissues of the tusk shown in Fig. 10
  Fig. 12. A tusk removed from the tuskless side of an elephant.
  Fig. 13. Section through the tusk shown in Fig. 12 ... 697
  Plate V.
  Fig. 14. A deformed tusk.
  Fig 15. A deformed tusk.
  Fig. 16. Section through the tusk shown in Fig. 14 at the position marked I ... 698
  Plate VI.
  Fig. 17. Section through the tusk shown in Fig. 14 at the position marked II.
  Fig. 18. Section through the tusk shown in Fig. 15 at the position marked in the illustration 699

Equisetum arvense, Pl. fig. 1 Sporophyte with (*a*) vegetative and (*b*) fertile branch (*c*) sporangia clustered round club-shaped head.
  Pl. fig. 2. One sporangium containing the spores in the four little pockets below the round top 1000

Erythrothrips asiaticus.
  Pl. fig. 1. Head and antennæ.
  Pl. fig. 2 Right fore-wing ... 1030

Euoplothrips malabarica.
  Pl. fig. 7. Fore-part of body. 1031

Euproctis icilia (Stinging Caterpillar).
  Fig. 1. Caterpillar clothed in urticating hairs 780
  Fig. 2. Caterpillar clothed all over in simple hairs ... 783
  Fig. 3. Caterpillar with conspicuous loose tufts ... 784
  Fig. 4. Caterpillar suddenly protruding brushes ... 784
  Fig. 5. Caterpillar fenced round with fringe of hairs 785

Euryaplothrips crassus.
  Fig. (*a*) Outline of insect, Fig. (*b*) Fore-wing... ... 1037

Felis leo, Map showing distribution 661

Felis leo bengalensis, Pl. fig. 1 648

Felis leo goojratensis, Pl. fig. 2 & Pl. 648, 655
  Skull, facial portion Pl. IV, fig. 1, skull, lateral view, Pl. IV, fig. 2 657
  Skull dorsal view Pl. V, fig. B. (1) skull, ventral view, Pl. V, fig. B. (2) 658

Felis leo persicus, Pl. figs. 1 & 2 644

Gleichenia, Pl. fig. 6 sporangium with oblique annulus *a*. 998

Gymnopteris variabilis, Pl. fig. 1, Fertile and sterile frond 993

Page

Hæmatopus ostralegus osculans Pl. fig. 1 859

Heligoland, Ornithological station:

Pl. I (*a*) Heligoland from the sea.

(*b*) On the beach, Dunen Island 744

Pl. II (*a*) 'Lange Anna'.

(*b*) General view of the Sapskuhle or Trapping Garden ... 745

Pl. III Removing trapped birds 746

Pl. IV (*a*) Ringing in progress at the Sapskuhle.

(*b*) A ringed Sparrow-hawk (*Accipiter nisus nisus*) ready to be released ... 747

Diagram to illustrate system of traps used in the Sapskuhle 748

Heliothrips kadaliphila.

Pl. Fig. 1. Anterior region of body.

Fig. 2. Right fore-wing 1031

Hemionitis arifolia.

Pl. Fig. 3. Fertile and sterile fronds ... 993

Hemiprocne longipennis.

Pl. Fig. 1. The bottom of the nest.

Fig. 2. Nest and egg.

Fig. 3. A young crested swift in its nest, adult birds in the background 772

Pl. Fig. 1. The nestling in a defensive pose.

Fig. 2. A young crested swift ... 773

Hemitragus jemlaicus.

Photo of malformation in skull 1057

Indian Birds (study of)

Fig. 1. Distribution of pigment centres in a bird ... 725

Fig. 2. Head of a bird to show how pigment centres affect pattern 726

Page

Iole icterica.

Pl. Fig. 1. At nest.

Fig. 2. Nest of 1028

Isoetus.

Pl. Fig. 3. Plant.

Fig. 4. Sporangium at base of leaf of same with small bract or *ligule* just above ... 1000

Ixobrychus minuta, on its nest Pl. 734

Leucopolius alexandrinus seebohmi, Pl. Fig. 2 613

Lindsaya cultrata, Pl. Figs. 8 & 9 994

Lycopodium Pl. Figs. 1-6 sporophytes 999

Lygodium.

Pl. Fig. 5. Sporangium capsule on very short stalk with annulus around the apex 998

Lutianus johnii, Pl. 977

Marsilia Sp., Pl. Fig. 7. Sporophyte 1000

Mesopodagrion tibetana.

Fore-wing Fig. 6 970

Anal appendages Fig. 7 ... 971

Molpastes cafer cafer.

Pl. Fig. 1. Nest of, fig. 2 on Nest 1026

Murænesox talabonoides.

Pl. Fig. 4 976

Mymarothrips garuda.

Pl. Fig. 5. Head with antennæ.

Fig. 6. Fore-wing ... 1030

Ophioglossum nudicaule.

Pl. Figs. 4 & 5. Sporangia enlarged 995

Osmunda.

Pl. Fig. 7. Sporangium—annulus reduced to slightly thickened cells at apex where capsule splits ... 998

Osmunda regalis.

Pl. Fig. 1 995

Panther (The) as I have known him.

Pl. III (*a*) A Kathiawar Panther.

(*b*) Vultures after a meal 680

PAGE

Papilio polytes romulus.
Freak example Pl. 832
Peltophorum ferrugineum Col. Pl. 718
Pl. 719
Persia, portion of south-west, map 922
Pillularia Sp.
Pl. Fig. 6. Sporophyte ... 1000
Pleopeltis lanceolata.
Pl. Figs. 10 & 11. Circular sori—no indusium 994
Ploceus philippinus.
Pls. 1-7. Nests ... 948–963
Polipodium.
Pl. Figs. 3 & 4. Sporangium capsule showing ruptured annules 998
Polynemus indicus, Pl. fig. 3 ... 976
Psilotum.
Pl. fig. 5. Sporophyte ... 1000
Rhinagrion mima.
Fore-wing fig. 3 968
Anal appendages fig. 4 ... 969
Markings of head and thorax fig. 5 970
Rucervus duvaucelli.
Photo. Head with nineteen points... 1060
Salvinia.
Pl. Fig. 8. Sporophyte ... 1000
Sciæna diacanthus Pl. Fig. 2... 976
Scolothrips asura.
Pl. Fig. 5. (*a*) Head and Prothorax.
(*b*) Antennæ.
(*c*) Fore-wing ... 1031
Selaginella.
Pl. Fig. 7. Sporophyte.
Fig. 8. Section of fertile branch showing microsporangium *mi.* in upper leaves macrosporangium, *ma.* in lower leaves.
Fig. 9. Microsporangium with microspores (enlarged 10 times.)
Fig. 10. Macrosporangium with macrospores (enlarged 10 times) ... 999
Spathodea campanulata, Col. Pl. 716
Victoria Gardens, Bombay ... 717
Flowers of 717
Spirogyra neglecta.
Pl. Branching of conjugation tubes 843
Squatarola squatarola hypomela
Pl. Fig. 1 613
Stenoloma chinensis.
Pl. Figs. 12 & 13. Closed sori 994
Tigers (Three at a kill) photo ... 796
Tradescantia discolor.
Pl. Fig. 1. Microphotograph of a longitudinal section of the stem 841
Tradescantia zebrina.
Pl. Fig. 2. Microphotograph of a longitudinal section ... 841
Tricomanes.
Pl. Figs. 14 & 15. Cup-shaped sorus with prolongation of column in centre on which sporangia are inserted 994
Trygon microps, Pl. Fig. 1 ... 976
Tryphactothrips rutherfordi.
Pl. Fig. 6. Fore part of body 1031
Ursus malayanus, photo ... 799

ERRATA

Vol. XXXIV, Nos. 3 and 4

Page 820, *line* 4 *for* **coramendelica** *read* **coromandelica**
,, ,, ,, 10 *for* **Chelidonias** *read* **Chlidonias**
,, 822 ,, 5 *for* **melanocephela** *read* **melanocephala**
,, ,, ,, 8 *from bottom for* **erythorgeuys** *read* **erythrogenys**
,, 827 ,, 23 *for* **tarqueola tarqueola** *read* **torqueola torqueola**
,, 856 ,, 36 *for* **Cursbrious** *read* **Cursorius**
,, ,, ,, 43 *for* **D. Macrocercus** *read* **macrocercus**
,, 871 ,, 10 *from bottom for* **Ægialitts** *read* **Ægialitis**
,, 878 ,, 21 *for* **foelida** *read* **fœtida**
,, 879 ,, 12 *from bottom for* **Kleinhovla** *read* **Kleinhovia**
,, 916 ,, 8 ,, ,, *for* **Blandford** *read* **Blanford**
,, 917 ,, 17 *for* **Blandford** *read* **Blanford**
,, 924, *Last line of Field Notes No. 10 for* **Nash** *read* **Naksh**
,, 926, *Field Notes No. 35. Heading should read* **Monticola saxitalis** *instead of* **axitalis**
,, ,, *line* 10 *from bottom for* **finchi** *read* **finschi**
,, 931, *Field Notes of Nos. 89 and 90 have been transferred. Those now shown under* **Marbled Duck** *should be for* **Shoveller** *and those under* **Shoveller** *for* **Marbled Duck**
,, ,, *line* 24 *for* **elucephala** *read* **leucocephala**
,, ,, ,, 7 *from bottom for* **Demegratta** *read* **Demiegretta**
,, 934 ,, 19 *for* **caudactus** *read* **caudacutus**
,, 1001 ,, 2 *from below for* **Polipodium** *read* **Polypodium**
,, 1012 ,, 3 *for* **Pontoporia** *read* **Pantoporia**
,, 1026 ,, 6 *from bottom for* **Micrsecelis** *read* **Microscelis**
,, 1040 ,, 6 ,, ,, *for* **Dondrothrips** *read* **Dendrothrips**
,, 1056 ,, 11 ,, ,, *for* 33½″ *read* 23½″
,, ,, ,, 24 ,, ,, *for* **Shingoshigar** *read* **Shingo-shigar**
,, 1073 ,, 7 *for* **Garruilus** *read* **Garrulus**

ERRATA

Vol. XXXIV, No. 2

Page 564, *Top line for* **Callousness** *read* **Callowness**
,, 590, *line* 9 *from bottom for* **Atlanta** *read* **Atalanta**

INDEX TO SPECIES

Page
Abelmoschus angulosus 634
——— esculentus 634
——— moschatus 634
——— rugosus 634
Abisara echerius 838
—————— prunosa 1014
——— fylla 838
Abroma augusta 884
Abrornis superciliaris subsp. 909
Abutilon asiaticum 629
——— avicennae 631
——— bidentatum 630
——— cornutum 630
——— crispum 630
——— fruticosum 630
——— glaucum 630
——— graveolens 630
——— hirtum 630
——— indicum 629
——— muticum 630
——— pannosum 630
——— polyandrum 629
——— ramosum 630
——— ranadei 629
——— theophrasti 630
——— tomentosum 630
Acacia arabica 779
Acanthopneuste nitidus viridanus ... 824
—————— occipitalis occipitalis. 824
Accentor modularis 749
Accipiter nisus 749
—————— nisus 930
Achalarus bifasciatus casyapa ... 838
Acridotheres tristis 806, 1076
—————— melanosternus ... 818
—————— tristis ... 825, 910
Acrocephalus arundinaceus orientalis. 908
——— bistrigiceps 908
——— stentoreus 818
Actinopteris 998
——— dichotoma 1001
Adanosnia digitata 637

Page
Adiantum capillus veneris 1001
——— sp. 994, 998
Ægialitis alexandrina 618, 620, 621
——— dealbatus 621
——— dubia 867, 868, 869
——— hiaticula 865
—————— tundræ 865
——— jerdoni 869
——— marginata 617
——— mongolica 873
——— placida 871
Ægithaliscus concinnus 1073
—————— iredalei ... 822
Ægithina tiphia 1063
—————— tiphia 672
—————— zeylonica 817
Æolothrips fulvicollis 1030
——— pandyani 1030, 1040
Æthiopsar f. fuscus 910, 1076
Æthopyga nepalensis horsfieldi ... 825
Ætobatis narinari 974
Agialida roxburghii 895
Agriolestes melanothorax 967
Agrobates galactodes familiaris ... 926
Alæmon alaudipes doriæ 924
Alauda arvensis 749
—————— intermedia 924
——— gulgula australis 818
—————— gulgula 914
—————— peguensis 914
Alcedo atthis bengalensis 826
—————— pallasii 928
Alcippe fraterculus 672
——— nepalensis subsp. 671
——— poioicephala phayrei ... 672
Alectoris græca waeræ 934
Alseonax latirostris 1075
—————— poonensis ... 824
Alsophila 999
Althaea ludwigii 627
Amadina striata 911
Amandava flavidiventris 911

Page
Amblypodia bazaloides 833
Ammomanes deserti fratercula ... 924
Ammoperdix griseogularis termeuleni 934
Amphilestes mima 969
Anapheis mesentina 838
Anaphothrips flavicinctus 1036
Anas acuta acuta 931
—— angustirostris 931
—— crecca 931
—— platyrhyncha 725
———— platyrhyncha ... 930
—— pœcilorhyncha zonorhyncha ... 810
—— strepera 930
Anastomus oscitans 820
Andropogon sorghum *var.* technicum. 847
Anemia 999
Angiopteris 997
—— evecta 996, 1002
Anopheles barbirostris 737
—— culicifacies 737
—— fuliginosus 737
—— jamesii 737
—— listonii 737
—— moghulensis 737
—— pallidus 737
—— rossii 737
—— stephensi 736, 737
—— subpictus 737
—— tessellatus 737
—— vagus 737
Anser sp. 930
Anthraceros coronatus coronatus ... 819
Anthrenus musorum 783
Anthrophyum 998
Anthus cervinus 914
—— hodgsoni hodgsoni ... 825, 914
—— pratensis 749
—— richardi richardi 914
———— rufulus 818
—— rufulus rufulus 914
—— sordidus decaptus 924
———— jerdoni 825
—— trivialis 749
Antichorus depressus 891
Apatura ambica 837
—— parisatis atacinus 1010
Apharitis lilacina 833
Aphnæus ictis nepalicus 838
—— vulcanus 838
Aporia agathon phryxe 838
—— soracta 838

Page
Aporion pristipoma 991
Appias albina 833
———— darada 1007
—— indra shiva 1006
—— libythea 833, 834
———— libythea 1006
—— lyncida latifasciata 1007
—— paulina wardii 1007
—— shiva 833
—— wardi 833
Aquila chrysaëtos 1078
—— clanga 929
—— heliaca heliaca 826
—— nipalensis nipalensis ... 826
Arachnothera magna aurata ... 915
Arborophila torqueola torqueola ... 827
Arceuthornis viscivorus 1074
———— bonapartei ... 824
Archangiopteris 997
Ardea cinerea cinerea ... 820, 931
—— purpurea manillensis 820
Ardeola grayi 820
Ardetta minuta 932
Argya caudata huttoni 926
—— earlii 670
—— gularis 670
Argynnis childreni sakontala ... 838
—— hyperbius 838
Arhopala atrax 838
—— centaurus 838
—— dodonea 838
—— ganesa 838
—— rama 838
Arius dussumieri 984
—— sona 984
—— sp. 983, 985
Artamus fuscus 818, 907
Asio flammeus flammeus 929
Aspidium 994, 995, 998, 1001
Aspidopterys canarensis 894
—— cordata 894
—— glomerata 894
Asplenium 998
—— normale 994, 1001
Astur badius 1078
—— trivirgatus trivirgatus 819
Atella alcippe mercea 1013
—— phalanta 837, 1013
Athene noctua bactriana 929
Augiades brahma 838
Anhinga melanogaster 820

PAGE

Aulocera padma ... 840
Auzakia dànava ... 837
Averrhoa carambola ... 899
—— bilimbi ... 899
Ayyaria chætophora ... 1034
Azanaza lampas ... 634
Balanites ægyptiaca ... 895
—— ferox ... 895
—— roxburghii ... 895
Bambusa arundinacea ... 1098
—— tulda ... 1099
Bandicota ... 940
Banisteria benghalensis ... 893
—— tetraptera ... 893
Baobabus digitata ... 637
Barbus ... 700
Bartramia indica ... 890
Belenois mesentina mesentina ... 1006
Bergia ammannioides ... 623
—— capensis ... 623
—— odorata ... 623
Bibos gaurus ... 801
Biophytum reinwardtii ... 899
—— sensitivum ... 899
Blechnum ... 998
Bombax ceiba ... 637
—— insigne ... 637
—— genuina ... 637
—— malabaricum ... 637
—— pentandrum ... 637
—— wightii ... 637
Botrychium ... 994, 999
—— daucifolium ... 1001
Bubo bubo subsp. ... 929
Bubulcus ibis coromandus ... 820
Buettneria herbacea ... 884
Bungarus cæruleus ... 1083
—— candidus ... 1085
Burmargiolestes melanothorax. 965, 966, 967
Buteo rufinus rufinus ... 827, 930
Butheolus bicolor ... 1051
—— melanurus ... 1051
Buthus acute-carinatus ... 1051
—— alticola ... 788, 1051
—— australis ... 1051
—— pachyurus ... 1051
—— rugiscutis ... 1051
—— tamulus ... 789, 1051
Byasa aristolochiæ aristolochiæ ... 1005
—— hector ... 1005

PAGE

Byasa jophon pandiyana ... 1005
Byblia ilithiya ... 1013
Calandrella brachydactyla brachydactyla ... 924
—— raytal raytal ... 914
Callacanthus burtoni ... 825
Callophis trimaculatus ... 1085
Calotes versicolor ... 1041
Colotis amata modesta ... 1007
—— danæ danæ ... 1007
—— etrida etrida ... 1007
—— eucharis ... 1007
—— fausta ... 1007
—— fulvia ... 1007
Calophyllum apetalum ... 625
—— burmanni ... 625
—— calaba ... 625
—— decipiens ... 625
—— elatum ... 625
—— inophyllum ... 625
—— spurium ... 625
—— thwaitesii ... 625
—— tomentosum ... 625
—— wightianum ... 625
Camellia thea ... 626
Camponotus compressus ... 785, 1095
Canis pallipes ... 1055
Capella gallinago gallinago ... 932
—— stenura ... 820
Caranx atropus ... 990
—— gallus ... 990
—— kurra ... 990
—— malabaricus ... 990
—— rottleri ... 990
—— sp. ... 990
Carcharias ... 989
Carduelis caniceps caniceps ... 825
—— carduelis niediecki ... 923
Carpodacus erythrinus roseatus ... 722
Casarca ferruginea ... 930
Castalius rosimon ... 838
Catachrysops strabo ... 838
Catopsilia crocale ... 1007
—— florella gnoma ... 1007
—— pomona ... 1007
—— pyranthe ... 838
—— —— minna ... 1007
Catræus wallichii ... 827
Ceiba pentandra ... 637
Celænorrhinus leucocera ... 838
—— pulomaya ... 838

Page
Centropus sinensis parroti ... 819
Cephalostachyum capitatum ... 1099
Cerchneis tinnunculus ... 1078
——— interstinctus ... 826
Ceropegia polyantha ... 936
Certhia himalayana ... 1074
——— himalayana ... 823
Cervus unicolor ... 1058
Ceryle lugubris guttulata ... 826
——— rudis leucomelanura ... 819
——— rudis ... 928
Cethosia nietneri mahratta ... 1013
Ceyx t. tridactylus ... 819
Chadara tenax ... 887
Chætoprocta odata ... 838
Chaimarrhornis leucocephalus. 811, 823, 1074
Chalamydotis undulata macqueeni ... 932
Chalcoparia s. singalensis ... 915
Chalcophaps indica robinsoni ... 819
Chaptia ænea ænea ... 908
Charadrius alexandrinus ... 618
——— seebohmi ... 620
——— atrifrons ... 873
——— curonicus ... 868
——— dubius curonicus ... 820, 868
——— dubius ... 867
——— jerdoni ... 827, 869
——— geoffroyi ... 875
——— hiaticulus ... 865
——— tundræ ... 865
——— hypomelus ... 617
——— leschenaultii ... 875
——— mongolus ... 873
——— peronii ... 622
——— placidus ... 871
Charasia dorsalis ... 1086
Charaxes fabius fabius ... 1010
——— polyxena imna ... 1010
Cheilanthes ... 998
Chelidorhynx hypoxanthum ... 824
Chibia hottentotta hottentotta ... 908
Chilades laius ... 838
Chilasa clytia clytia ... 1005
——— *var.* dissimilis ... 1005
Chirocentrus sp. ... 991
Chirothrips manicatus ... 1031
Chlidonias leucopareia indica... 820, 827
——— leucopareia ... 933
——— leucoptera ... 933
Chorinemus ... 987
Chloropsis a. aurifrons ... 672

Page
Chloropsis cochinchinensis cochinchinensis ... 672
——— hardwickii malayana ... 672
———icterocephalachlorocephala. 672
Chrysocolaptes guttacristatus stricklandi ... 819
Chrysophrys berda ... 986
Ciconia ciconia ... 932
Circaetus gallicus ... 929
Circus æruginosus ... 930
——— cyanus ... 930
Cirrepedesmus ... 873
——— leschenaultii ... 875
——— mongolus ... 873
——— atrifrons ... 873
Cirrochroa thais thais ... 1013
Cissa c. chinensis ... 668
Cissus quadrangularis ... 828
Cisticola juncidis cursitans ... 908
Clamator jacobinus ... 790, 1071
——— taprobanus ... 819
Clupea longiceps... 991
Clupea sp. ... 990
Coladenia indrani ... 838
Colias fieldii edusina ... 838
Collocalia ... 774
Coluber helena ... 1085
Columba livia intermedia ... 819
——— subsp. ... 934
Copsychus saularis ... 953, 1074
——— ceylonensis ... 818
Coracias garrulus semenowi ... 929
Corchorus æstuans ... 892
——— antichorus ... 891
——— capsularis ... 891
——— depressus ... 891
——— fascicularis ... 891
——— microphyllus ... 892
——— olitorius ... 891
——— tridens ... 892
——— trilocularis ... 891
——— urticæfolius ... 892
Corvus corax lawrencei ... 923
——— cornix ... 749
——— coronoides ... 1072
——— andamanensis ... 668
——— culminatus ... 817
——— intermedius... 822
——— splendens... 1072
——— insolens ... 668
——— protegatus ... 817

PAGE
Coturnix coromandelica ... 820
——— coturnix coturnix ... 935
Crex crex ... 933
Criniger burmanica ... 901
——— griseiceps ... 901
——— tephrogenys burmanicus ... 901
Croce filipennis ... 834
Crocethia alba ... 932
Crocodilus porosus ... 1086
Crypsirhina varians ... 669
——— cucullata ... 669
Cuculus canorus ... 1068, 1077
——— ——— canorus ... 928
——— micropterus ... 1077
——— oplatus ... 826, 1077
Culicicapa ceylonensis ... 776
——— ——— ceylonensis. 824, 905
Cuon dukhunensis ... 1054
Cupha erymanthis maja ... 1013
Curetis bulis ... 838
Cursorius gallicus gallicus ... 932
Cyaniris albocærulea ... 838
——— argiolus cœlestina ... 838
——— huegeli ... 838
——— puspa ... 838
Cyanosylvia suecica robusta ... 903
Cyathea ... 999
Cyathodium cavernarum ... 845, 846
——— kashyapii ... 845, 846
Cybium commersonii ... 987
——— interruptum ... 987
——— guttatum ... 987
——— kuhlii ... 987
——— lineolatum ... 987
——— sp. ... 990
Cycas circinalis ... 1101
——— medica ... 1102
——— revoluta ... 1102
——— rumphii ... 1102
——— siamensis ... 1102
Cymbirhynchus affinis ... 915
Cynoglossus elongatus ... 988
——— lingua ... 988
——— sindensis ... 988
Cynthia erota saloma ... 1013
Cyornis rubeculoides dialilæma ... 905
——— ——— rogersi ... 905
——— superciliaris ... 1075
——— ——— superciliaris ... 824
——— tricolor ... 1075
Cyrestis thyodamas ... 837

PAGE
Cyrestis thyodamas indica ... 1012
Daboia russelli ... 1086
Danaea ... 997
Danais aglea aglea ... 1008
——— agleoides ... 837
——— chrysippus ... 837, 1008
——— limniace ... 837
——— ——— mutina ... 1008
——— melissa dravidarum ... 1008
——— nilgiriensis ... 1008
——— plexippus ... 837, 1008
——— septentrionis ... 837
——— tytia ... 837
Darpa hanria ... 838
Davallia ... 995, 998
Delias belladonna ... 838
——— eucharis ... 838, 1006
——— sanaca ... 838
Delichon urbica ... 928, 1076
Demegretta asha ... 931
Dendrocalamus brandisii ... 1098
——— giganteus ... 1099
——— hookeri ... 1099
Dendrocitta kinneari ... 668
——— rufa ... 668
——— sclateri ... 669
——— vagabunda ... 669
Dendrocygna javanica ... 821
Dendronanthus indicus ... 913
Dendrophasa pompadora ... 819
Dendrothrips dwivarna ... 1032, 1040
Desmodus rufa ... 1053
Deudoryx epijarbas ... 838
Dicæum cruentatum ignitum ... 915
Dicerobatis ... 974
Dichorragia nesimachus ... 837
Dicksonia ... 999
Dicrurus leucophæus ... 907, 1075
——— ——— stevensi ... 824
——— longicaudatus ... 908
——— macrocercus ... 730, 907, 1075
——— ——— albirictus ... 824
Dictyocarpus truncatus ... 628
Dilipa morgiana ... 840
Dipsadomorphus trigonatus ... 1085
Dipterocarpus indicus ... 626
——— tuberculatus ... 1102
——— turbinatus ... 626
Discophora lepida lepida ... 1009
Dissemurus paradiseus ceylonensis ... 818
——— rangoonensis ... 908

PAGE
Dissura episcopus episcopus 820
Dodona dipœa 838
——— durga 838
——— egeon 838
——— eugenes 838
——— ouida 838
Doleschallia bisaltide malabarica ... 1012
Dombeya acutangula 882
——— natalensis 882
——— spectabilis 882
Drepane punctata 984, 985
Drymoglossum 996, 998
———— pilosella 1001
Dryobates auriceps 826, 1077
——— himalayensis 1076
—————— himalayensis 825
——— major major... 749
——— syriacus 928
Dumortiera hirsuta 845
Echis carinata 1086
Egretta intermedia intermedia ... 820
Elæocarpus ganitrus 892
——— oblongus 892
——— serratus 892
——— tuberculatus 892
Elaphoglossum 996, 998
———— conforme 1001
Elaphus 694, 699
Elymnias hypermnestra caudata ... 1009
Emberiza aureola 912
——— calandra calandra 923
——— cia stracheyi 825
——— f. fucata 911
——— hortulana 924
——— melanocephala 924
——— pusilla... 911
——— rutila 912
——— stewarti 721
Engraulis sp. 990
Enicurus immaculatus 903
——— maculatus 1074
—————— guttatus 903
—————— maculatus ... 823
Ephippus orbis 984, 985
Epimys 943
——— rufescens 943, 944
Equisetum arvense 1000, 1002
Equula sp. 990
Erebia annada 837
——— hyagriva 837, 840
——— scanda 837

PAGE
Ergolis ariadne indica 1014
——— merione 838
—————— merione 1014
Eribœa athamas agrarius 1010
——— schreiberi wardi 1010
Erinocarpus nimmonii 889
Eriodendron anfractuosum 637
———— pentandrum 637
Eriolæna candollei 880, 881
——— flavescens 881
——— hookeriana 880, 881
——— lushingtonii 880
——— quinquelocularis ... 880, 881
——— stocksii 880, 881
Erismatura leucocephala 931
Erithacus rubecula hyrcanus 927
Erodium chumbulense 896
——— cicutarium 897
——— heliotropioides 896
Erolia alpina alpina 932
——— minuta 820
Erpornis x. xantholeuca 672
Erythrothrips asiaticus 1029, 1040
Eryx conicus 1086
Euaspa milionia 838
Eudromius morinellus 932
Eudynamis scolopaceus 1077
———————— scolopaceus... 819
Eulabes javana intermedia 910
Eulepis athamas 837
Euoplothrips malabarica ... 1039, 1040
Euplœa core core 1008
——— coreta coreta 1008
——— klugii kollari 1008
Euproctis icilia 778
Euripus consimilis meridionalis ... 1010
Eurya japonica 625
Euryaplothrips crassus ... 1037, 1038
Euthalia evelina laudabilis ... 1011
——— garuda 837
—————— meridionalis ... 1011
——— lepidea miyama 1010
——— lubentina 837
—————— arasada 1011
——— nais 1011
——— patala 837
——— telchinia 1010
Fagonia arabica 895
——— bruguieri 895
——— cretica 895
—————— *var.* arabica ... 895

PAGE
Fagonia diversifolia 895
——— echinella 895
——— mysorensis 895
Falco tinnunculus tinnunculus ... 929
Felis asiaticus 643, 659
—— barbaricus 660
—— bengalensis 648
—— goojeratensis 645
—— goojratensis ... 649, 653, 659
—— guzeratensis 645
—— leo asiaticus 660
——— bengalensis 660
——— goojratensis 660
——— gougeratensis 660
——— gozeratensis 660
——— guzeratensis 660
——— indicus 650, 660
——— persicus ... 643, 659, 660
Fimbriaria augusta 845
Firmiana colorata 879
Francolinus francolinus 1079
————— asiæ 827
———— vulgaris arabistanicus ... 934
Franklinia gracilis 908
——— r. rufescens 908
Fringilla cœlebs 748, 749
————— cœlebs 923
Fulica atra atra 933
Fulmekiola indica 1034
Gaertnera racemosa 893
Galerida cristata magna 924
Gallinula chloropus 933
Gallus bankiva murghi 827
—— lafayettii 820
Gampsorhynchus r. rufulus 670
————— r. torquatus ... 671
Garcinia cambogia 623
——— indica 623
——— malabarica 623
——— morella 624
——— ovalifolia 624
————— maorantha ... 624
——— papilla 624
——— pictoris 624
——— spicata 624
————— macrantha ... 624
——— tinctoria 624
——— xanthochymus 624
Garrulax albogularis 1073
————— albogularis ... 822
——— leucolophus belangeri ... 669

PAGE
Garrulax leucolophus leucolophus ... 822
——— moniliger fuscata ... 670
——— pectoralis pectoralis ... 669
Garrulus bispecularis 1073
————— bispecularis ... 822
——— lanceolatus ... 822, 1073
————— leucotis... ... 669
Gazza sp. 990
Gelochelidon n. nilotica 820
Gennæus hamiltoni 827, 1079
Geocichla c. citrina 904
Geranium heliotropioides 896
——— larvianum 896
——— peltatum 896
Gerbilus cuvieri 939
——— indicus 939
Gerres sp. 990
Glaucidium brodiei 735, 1077
————— brodiei 826
————— cuculoides cuculoides ... 826
Gleichenia 999, 1002
Golunda meltada 942
Gonepteryx rhamni nepalensis ... 838
Gordonia obtusa 625
Gossypium acuminatum 636
——— arboreum 636
————— *var.* neglectum. 636
——— bakeri 635, 636
——— barbadense 636
————— *var.* barsiliense 636
——— brasiliense 636
——— herbaceum 635
————— *var.* wightianum 635
——— hirsutum 636
————— *var.* religiosa ... 636
——— jamaicense 636
——— latifolium 636
——— nanking 636
————— *var.* bani ... 636
————— roji .. 636
————— rubicunda. 636
——— neglectum 635
——— obtusifolium 635
————— *var.* wightianum 635
——— punctatum 636
——— stocksii 635
Gracupica burmanica 910
Grammatoptila striata striata ... 822

Page
Graucalus macei siamensis ... 907
Grewia abutilifolia ... 888
——— asiatica ... 888
——— aspera ... 888
——— betulæfolia ... 887
——— bracteata ... 886
——— carpinfolia ... 886, 888
——— chadara ... 887
——— columnaris ... 886
——— damine ... 887
——— disperma ... 888
——— flavescens ... 888
——— heterotricha ... 886, 887
——— hirsuta ... 889
——— lævigata ... 888
——— membranacea ... 887
——— microcos ... 889
——— obtusa ... 886
——— orbiculata ... 887, 888
——— orientalis ... 886
——— pilosa ... 886, 887, 888
——— polygama ... 885
——— populifolia ... 887
——— rhamnifolia ... 886
——— ribesiæfolia ... 887
——— ritchiei ... 886
——— rotundifolia ... 887
——— subinaequalis ... 888
——— tiliæfolia ... 887
————————— *var.* leptopetala. 888
——— tenax ... 887
——— umbellata ... 885
——— umbellifera ... 886, 887
——— villosa ... 888
Guaiacum officinale ... 895
Guazuma tomentosa ... 885, 889
Gunomys kok ... 940
Gymnogramme ... 998
Gymnopteris variabilis ... 1001
Gymnoris xanthocollis ... 1076
Gynaikothrips chavicæ ... 1040
————— interlocatus ... 1040
————— kannani ... 1040
————— malabarica ... 1040
————— moultoni ... 1040
————— pallipes ... 1040
————— uzeli ... 1040
Gypaëtus barbatus ... 1078
——————— hemachalanus ... 826
Gyps himalayensis ... 826, 1078
—— indicus ... 1078

Page
Hæmatopus ... 859
————— longipes ... 863
————— osculans ... 863
————— ostralegus ... 860, 863
——————————— malacophaga... 859
——————————— occidentalis ... 859
——————————— osculans. 860, 863
——————————— ostralegus. 859, 860
Hæmatospiza sipahi ... 721
Halcyon smyrnensis fusca ... 826
————————— generosa ... 819
————————— smyrnensis ... 928
Haliaëtus leucogaster ... 819
Haliastur indus ... 819
——————— indus ... 827
Haplothrips (Trybomiella) ramakrishnai ... 1038
——————————— tirumalraoi ... 1038
Harpodon nehereus ... 990
Hebomoia glaucippe australis ... 1007
Helicteres isora ... 879
Heliothrips kadaliphila ... 1033, 1040
Helminthostachys ... 996
Hemichelidon sibirica cacabata ... 904
——————————— gulmergi ... 904
Hemionitis ... 994, 996, 998
————— arifolia ... 1001
Hermitragus jemlaicus... 1057
Hemiprocne comata comata ... 772
—————— coronata ... 772, 819
—————— longipennis ... 772
————————— harterti ... 772
Hemipus picatus ... 906, 1075
Hemixus f. flavala ... 901
————— maclellandi ... 901
——————————— maclellandi. 823
Heritiera ... 879
Herpestes vitticollis ... 1054
Hestia lynceus malabarica ... 1008
Hibiscus abelmoschus ... 634
———— angulosus ... 634
———— cæsius ... 633
———— cannabinus ... 633
———— collinus ... 633
———— esculentus ... 634
———— ficulneus ... 633
———— furcatus ... 632
———— gibsoni ... 633
———— hirtus ... 632
———— intermedius ... 632

Page
Hibiscus intermedius *var.* aristaevalvis. 632
——— lampas 634
——— lobatus 632
——— lunariifolius 633
——— manihot 633
——— micranthus 632
——— mutabilis 634
——— panduræformis 633
——— platanifolius 633
——— populneoides 635
——— populneus 635
——— punctatus 633
——— radiatus 632
——— rosa sinensis 634
——— rugosus 634
——— sagittifolia 634
——— setinervis 634
——— solandra 632
——— surattensis 632
——— syriacus 634
——— tetraphyllus 633
——— tiliaceus... 634
——— tortuosus 634
——— trionoides 632
——— trionum 632
——— vitifolius 633
Hieraetus pennatus 929
Hierococcyx 730
———— sparveroides 826
Hildegardia populifolia... 878
Himantopus h. himantopus 820
Hiptage benghalensis 893
——— madablota 893
Hiræa cordata 894
Hirundo daurica 1076
———— erythropygia ... 818
——— rufula japonica 912
——— rustica gutturalis 912
———— rustica... 927
Hopea glabra 626
——— wightiana 626
Horaga onyx 838
Hugonia mystax 893
Huphina nadina remba 1006
——— nerissa evagete 1006
Hyarotis adrastus 838
Hydatothrips ramaswamiahi 1032
Hydrophasianus chirurgus 820
Hymenophyllum 998
Hypacanthis spinoides spinoides ... 825
Hypericum japonicum 623

Page
Hypericum mysorense 623
Hypocolius ampelinus 1061
Hypolimnas bolina 837, 1012
———— misippus 837, 1012
Hypothymis azurea styani 905
Hysudra selira 838
Ianthia cyanura rufilata 823
Ibis leucocephalus 820
Ichthyophaga humilis plumbeus ... 827
Ictinætus malayensis perniger ... 826
Ilerda sena 838
Iole icterica 1027
—— olivacea virescens 902
Irania gutturalis 927
Iracta timoleon 838
Irena p. puella 909
Ismene ataphus 838
Isoetes 1000, 1002
Isopera pedunculata 1095
Issoria sinha 837
Ixias marianne 1007
—— pyrene frequens 1007
Ixobrynchus minutus 730, 734
Ixulus flavicollis flavicollis 823
Iynx torquilla 730, 734
Junonia hierta 837
——— iphita 837
——— lemonias 837
——— orithya 837
Jussiæa edulis 891
Kallima inachus 837
——— philarchus horsfieldii... ... 1012
Kaulfussia 996, 997
Ketupa ketupa semenowi 929
Kittacincla macroura indica 818
———— ——— indica 903
————malabarica malabarica ... 903
Kittelocharis trigyna 893
Kleinhovia hospita 879
Kydia calycina 629
Lactarius delicatulus 990
Laguna lobata 632
Laiscopus himalayanus 824
Lalage melaschista melaschista ... 824
———— ———— siamensis 907
——— sykesii 818
Lanius collurio 925
——— colluroides 905
——— c. cristatus 809, 905
——— cristatus phœnicuroides ... 925
——— excubitor aucheri 925

Page
Lanius excubitor pallidirostris ... 925
——— isabellinus ... 925
——— nubicus ... 925
——— n. nigriceps ... 905
——— schach tephronotus ... 905
——— senator niloticus ... 925
——— tephronotus ... 807
Larus argentatus cachinaus ... 933
——— genei ... 933
——— ridibundus ridibundus ... 933
Lates sp. ... 990
Lebretonia glechomaefolia ... 631
——— procumbens ... 631
Leggada booduga ... 919, 921, 943
——— cervicolor ... 917
——— dunni ... 918
——— lepida ... 919, 921
——— lepidoides ... 921
——— nagarum ... 918
——— palnica... ... 919
——— terricolor ... 917, 921
Leggadilla ... 916
Leiopicus mahrattensis... ... 1077
Leioptila capistrata ... 1073
——— capistrata... ... 822
Leo asiaticus ... 644, 660
Leptocoma asiatica intermedia ... 915
——— lotenia ... 819
——— zeylonica ... 1066, 1068
Leptogomphus assimilis ... 753
——— bidentatus sp. nov. ... 752
——— gestroi ... 753
——— gracilis... ... 753
——— inclitus ... 753
——— lansbergei ... 753
——— perforatus ... 753
——— retroflexus ... 753
——— sauteri ... 753
——— scorpio ... 753
——— semperi... ... 753
Leptoptilus javanicus ... 820
Leptosia nina nina ... 1006
——— xiphia ... 838
Lestes patricia ... 965
Lethe confusa ... 837
——— drypetis todara ... 1009
——— dyrta ... 837
——— europa ragalva ... 1008
——— insana ... 837
——— pulaha ... 837
——— rohria nilgiriensis ... 1008

Page
Lethe vaivarta ... 837
——— verma ... 837
——— yama ... 837
Leucopolius alexandrinus alexandrinus. 618
——— dealbatus... 621
——— seebohmi... 620
Leucopolius peronii ... 622
Libythea celtis lepita ... 838
——— lepita lepitoides ... 1014
——— myrrha carma ... 1014
——— rama... ... 838
Liminitis procris undifragus ... 1011
Lindsaya ... 998
——— cultrata ... 994, 1001
Linum cicanobum ... 893
——— mysorense ... 892
——— repens ... 893
——— tetragynum ... 893
——— trigynum... ... 893
Liothrix lutea callipyga ... 823
Littorella lacustris ... 1000
Lobelia dortmanni ... 1000
Lobivanellus indicus ... 729, 1079
——— atronuchalis ... 932
Lophoceros g. gingalensis ... 819
Lophophanes dichrous dichrous ... 822
——— melanolophus ... 822
Loxura atymnus ... 838
Lutianus annularis ... 982
——— argentimaculatus ... 983
——— gibbus ... 983
——— johnii ... 982, 985
——— kasmira ... 983
——— lineolatus ... 983
——— rivulatus ... 983
——— roseus ... 983
Lycodon aulicus ... 1085
Lycopodium ... 999, 1002
Lygodium ... 999, 1002
Lyroderma lyra ... 1052
Machlolophus xanthogenys xanthogenys ... 822, 1073
Macrolinum trigynum ... 893
Macropisthodon plumbicolor... ... 1085
Malva coromandeliana... ... 627
——— tricuspidata ... 627
Malvastrum coromandelianum ... 627
——— tricuspidatum ... 627
Marattia ... 996, 997
Marchantia palamata ... 845
——— polymorpha ... 845

PAGE
Marsilia quadrifolia 997
———— sp. 1002
Megaderma spasma 1053
Megalaima virens 1077
——————— marshallorum ... 826
Megalurus palustris palustris 908
Melanitis leda ismene 837, 1009
——— phedima veraha 1009
——— zitenius gokala 1009
Melhania abutiloides 883
——— abyssinica 883
——— denhami 883
——— futteyporensis 883
——— hamiltoniana 883
——— incana 883
——— tomentosa 883
Melocanna bambusoides 1099
Melochia arborea 884
——— corchorifolia 883
——— indica 884
——— truncata 628
——— umbellata 883
——— velutina 884
Melophus melanicterus 912
Merops apiaster 928
——— orientalis beludschicus ... 928
——————— orientalis 819
——— superciliosus persicus ... 928
Mespodagrion tibetana ... 970, 971, 972
Mesua ferrea 625
Microchloena quinquelocularis ... 881
Microcichla scouleri 811
Microhierax cœrulescens 1078
Micropus affinis 1077
——————— affinis 774, 790, 826
——— melba 1077
——————— melba 826
Microscelis psaroides 1074
————————— ganeesa 1026
————————— nigrescens ... 901
————————— psaroides ... 823
Microtarsus m. melanocephalus ... 902
——————— poiocephalus 1028
Millardia meltada 942
Milvus migrans 1078
——————— migrans 930
——————— govinda ... 819, 827
Mirafra assamica affinis 818
——————— microptera 914
Miscornis rubricapilla sulphureus ... 671
Molpastes cafer 1063, 1074

PAGE
Molpastes cafer cafer 1026
———— hæmorrhous burmanicus ... 901
——————— intermedius ... 823
——————— hæmorrhous... 818
———— leucogenys... 1074
——————— leucogenys ... 823
Monogramme 998
Monsonia asiatica 896
——— chumbalensis 896
——— heliotropioides 896
——— hispida 896
——— lawiana 896
——— mallica 896
——— senegalensis 896
Monticola affinis 904
——— cinclorhyncha ... 824, 1075
——— erythrogastra 824
——— pandoo 904
——— saxitalis 926
——— solitaria 904, 1075
——————— longirostris ... 926
Motacilla alba dukhunensis ... 825, 924
——————— leucopsis 913
——— cinerea caspica ... 825, 913
——— citreola citreola 913
——— flava simillima 913
——————— thunbergi 818
——— thunbergi 913
——— sp. 924
Mougeotia sp. 843
Muræna tessalata 981
——— undulata 981
Muræenesox cinereus 981
———— talabon 981
———— telabonoides ...981, 982, 985
Mus booduga 943
—— dunni 918
—— kok 940
—— lepidus 920, 943
—— meltada 942
—— rattus 943, 944
—— rufescens 944
—— (Leggada) booduga. 916, 917, 918
——————— cervicolor ... 916, 917
——————— fulvidiventris... ... 920
——————— kakhyensis 921
——————— viculorum 921
Muscadivora ænea pusilla 819
Mycalesis adolphei 1008
——— anaxias anaxias 1008
——— igilia... 1008

Page
Mycalesis khasia orcha 1008
——— mineus polydecta 1008
——— nicotia 837
——— patnia junonia 1008
——— perseus 837
——— ——— typheus 1008
——— subdita 1008
Mycerobas melanoxanthus 825
Myiophoneus t. temminckii. 811, 824, 904, 1075
Myliobatis 974
Mymarothrips garuda 1031, 1040
Naia tripudians 1082, 1085
Neophron percnopterus ... 930, 1078
——— ——— percnopterus. 826
Nephrodium 998
Nephrolepis 998
Neptis ananta 837
——— astola 837
——— columella nilgirica 1012
——— hordonia hordonia 1012
——— hylas varmona 1012
——— mahendra 837
——— nandina hampsoni 1012
——— narayana 837
——— sankara 837
——— soma 837
——— ——— kallaura 1012
——— viraja kanara 1012
——— yerburyi 837
——— zaida 837
Nesocia 939
——— bengalensis 940
Nesokia 939
Netta rufina 931
Nettopus coromandelianus ... 725, 821
Niltava sundara sundara 824
Notocrypta feisthamelii 838
Notodela leucura 903
Numenius arquata lineata 932
Nycticejus castaneus 775
——— grisêus 729
Nycticorax n. nycticorax ... 820, 931
Nyroca ferina 931
——— fuligula 809, 931
——— nyroca 931
——— rufa baeri 810
Ochlandra rheedii 1098
——— travancorica 1098
Ochrocarpos longifolius 624
Œdicnemus recurvirostris 809

Page
Œnanthe alboniger 927
——— deserti albifrons 926
——— finschi 926
——— isabellina 926
——— œnanthe œnanthe ... 926
——— picata 927
——— xanthoprymna chrysopygia. 927
Oligodon arnensis 1085
——— subsgriseus 1085
Ophioglossum 996
——— ——— nudicaule 1001
Oreicola ferrea 1074
——— ——— ferrea 823, 903
——— jerdoni 903
Oreocincla dauma 1075
——— ——— dauma ... 824, 904
Oriolus chinensis tenuirostris 909
——— oriolus 1076
——— ——— oriolus 923
——— trailii 910
——— xanthonotus ceylonensis ... 818
——— xanthornus xanthornus ... 909
Orsotriæna medus mandata 1009
Orthotomus sutorius patia 908
——— ——— sutorius ... 818
Osmunda 996, 999, 1002
——— regalis 1001
Otocompsa emeria 1070
——— ——— fuscicaudata. 1024, 1064
——— ——— peguensis ... 902
——— flaviventris 902
——— jocosa erythrotis ... 902
Otolithus rubber 990
Otus brucei 929
——— spilocephalus 1077
——— ——— huttoni 826
——— sunia 724
Oxalis corniculata 898
——— ——— *var.* corniculata ... 898
——— ——— hispida ... 898
——— gracilenta 899
——— latifolia 898
——— senistiva 899
——— tetraphylla 898
Oxythrips hemavarna 1035
Pagoa leschenaulti 932
Pagus major 986
——— spinifer 986
Palamnæus bengalensis 1051
——— fulvipes 1051
——— gravimanus 1051

PAGE
Palamnæus liurus 1051
——— longimanus 1051
——— phipsoni 1051
——— swammerdami 1051
——— xanthopus 1051
Panchætothrips indicus 1037
Panthera 673, 693
——— leo persicus 660
Pantholops hodgsoni 1056
Pantoporia asura 837, 1012
——— nefte inara 1011
——— opalina 837, 1012
——— perius 837
——— ranga karwara 1012
——— selenophora 837
—————— kanara ... 1012
Papilio agestor govindra 838
——— buddha 1005
——— cloanthus 838
——— clytia dissimilis 838
——— crino 833, 1005
——— demoleus 838
—————— demoleus 1005
——— demolion liomedon 1005
——— dravidarum 1005
——— eurous cashmirensis ... 838
——— hector 832
——— helenus daksha 1005
——— machaon asiatica 838
——— paris tamilana 1005
——— polyctor 838
——— polymnestor polymnestor ... 1005
——— polytes *var.* cyrus 1005
—————— romulus 832, 838, 1005
——— protenor 838
——— sarpedon 838
Pararge moorei 840
——— schakra 837
Parantirrhœa marshalli ... 833, 1009
Pareronia ceylanica ceylanica ... 1007
——— valeria hippia 1008
Paritium tiliaceum 634
Parthenos sylvia virens 1011
Parus major 1073
——— cinereus 669
——— monticolus 1073
—————— monticolus ... 822
Passer domesticus 1076
—————— confuscius ... 818, 911
—————— indicus 825
—————— nigricollis 911

PAGE
Passer flaveolus 911
——— hispaniolensis transpicus ... 923
——— montanus 911
—————— malaccensis ... 911
——— rutilans 1076
—————— debilis 825
Pathysa antiphates naira 1005
Pavo cristatus 723, 820
Pavonia arabica 631
——— glechomifolia 631
——— odorata 631
——— platanifolia 633
——— procumbens 631
——— zeylanica 631
Pedestes masuriensis 838
Peganum harmala 894
Pelargonium inquinans 897
——— laterpes 897
——— peltatum 896
——— quercifolium 897
——— radula 897
——— zonale 897
Pelecanus philippensis 820
——— sp. 930
Pellona sp. 990
Pellorneum minus 671
——— ruficeps subsp. 671
——— tickelli subsp. 671
Peltophorum ferrugineum 717
Pentapetes phœnicea 882
——— suberifolia 880
Penthoceryx sonneratii 727
—————— waiti 819
Pericrocotus brevirostris 1075
—————— brevirostris. 824
——— flammifer 906
——— fraterculus 906
——— peregrinus vividus ... 907
——— roseus roseus 907
——— speciosus 1061
—————— elegans ... 906
Perissospiza icteroides icteroides ... 825
Phalacrocorax carbo sinensis ... 827
—————— subcormoranus. 930
——— fuscicollis 820
——— javanicus 820
——— pygmæus 930
Phœnicopterus ruber antiquorum 821, 931
Phœnicurus erythronota 927
——— frontalis 823
——— ochrurus ... 748, 749

PAGE
Phœnicurus ochrurus ochrurus ... 927
——————— phœnicuroides 927
Phragmaticola ædon 909
Phylloscopus humii 824
——— sibilatrix 748
——— subsp. 926
Picus squamatus 1076
——— squamatus 825
—— vittatus 1076
Pieris brassicæ 838
—— canidia 838
Pillularia sp. 1002
Pitta c. cucullata 915
—— moluccensis 915
—— nepalensis 915
Plagiochasma appendiculatium ... 846
——— articulatum 846
Plagusia bilneata 988
——— marmorata 988
Platacanthomys lasiurus 945
Platalea leucorodia major 820
Platycerium 998
Platyzoma 999
Pleopeltis 998
——— lanceolata 1001
Ploceëlla chrysæa 910
Ploceus baya 910
——— manyar flaviceps ... 818, 911
——— peguensis 911
——— striatus 911
——— passerinus passerinus... ... 910
——— philippinus 818, 910, 947
Plotosus arab 984
Pluvialis dominicus fulvus 820
Padagrion 960
Podiceps albipennis 1081
——— cristatus cristatus 933
——— ruficollis capensis 827
————— iraquensis 933
Poinciana regia 719
Polyanthus tuberosa 841
Polydontophis subpunctatus 1085
Polynemus heptadactylus 980
——— indicus ... 979, 980, 985
——— paradiseus 980
——— plebeius 979, 980, 985
——— sextarius 980, 990
——— tetradactylus ... 979, 980, 985
Polyommatus boeticus 838
Polypodium 998, 1001
Pomatorhinus erythrogenys ... 1073

PAGE
Pomatorhinus erythrogenys erythrogenys... 822
——————— haringtoni ... 822
————— ferruginosus albigularis ... 670
————— nuchalis 670
————— schisticeps mearsi ... 670
Pongamia glabra 1091
Porzana porzana 933
——— pusilla pusilla 933
Precis almana almana... 1013
—— atlites 1013
—— hierta hierta 1013
—— iphita pluviatilis 1013
—— lemonias vaisya 1013
—— orythyia swinhoei 1013
Prinia f. flaviventris 909
—— inornata 1065, 1068
———— blanfordi 909
———— burmanica 909
—— s. socialis 818
Prioneris sita 833, 1006
Pristipoma maculatum 978, 979, 985
Propasser rhodochrous 825
Protactia alboguttata 1096
Prunella modularis 748
Psarisomus dalhousiæ 915
Psaroglossa s. assamensis 910
Pseudergolis wedah 838
Pseudogyps bengalensis ... 826, 1078
Pseudorhombus arsius 988
Psilotum 1000, 1002
Psittacula e. eupatria 819
——— krameri krameri 790
————— manillensis ... 819
——— schisticeps 1077
————— schisticeps ... 826
Psettodes erumei... 988
Pterocles alchata caudacutus 934
——— senegallus 934
Pteris sp. 994, 995, 998, 1001
Pterocymbium javanicum 878
Pteroplatea micrura 974, 975
Pterospermum acerifolium 880
———— aceroides 880
———— heyneanum 880
———— reticulatum 880
———— suberfolium 880
Pteruthius erythropterus 823
Pterygota alata 879

PAGE
Pterygota roxburghii ... 879
Ptyonoprogne obsoleta obsoleta ... 928
Pucrasia macrolopha macrolopha 827, 1062
——— m. castanea ... 1062
Pycnonotus blanfordi ... 902
——— gularis ... 1028
——— leucotis mesopotamiæ ... 925
——— luteolus ... 818
Pyctorhis s. sinensis ... 671
Pyrrhocorax pyrrhocorax ... 923
Pyrrhulauda grisea ... 818
Python molurus ... 1086
Querquedula querquedula ... 821
Rallus aquaticus korejewi ... 933
Ramphalcyon c. gurial ... 819
Rapala melampus ... 838
——— nissa ... 838
——— schistacea ... 838
Rattus rattus ... 943
——— rufescens ... 944
——— wroughtoni ... 944
Reboulia hemispherica ... 846
Regulus regulus... ... 749
Reinwardtia indica ... 893
——— repens ... 893
——— tetragyna ... 893
——— trigyna ... 893
Reticulothrips peringueyi ... 1034
Rhinagrion macrocephala ... 968
——— mima ... 968, 969
——— tibetana ... 969, 972
Rhinoptera ... 974
Rhipidura a. albicollis ... 905
——— aureola burmanicus ... 905
——— compressirostris ... 818
Rhipiphorothrips cruentatus ... 1034
Rhopalocampta benjaminii ... 838
Rhopodytes viridirostris ... 819
Rhyacornis fuliginosa ... 811
——— fuliginosa ... 823
Rhynchobatus djeddensis ... 974
Riccia cruciata ... 846
——— fluitans ... 846
——— himālaynesis ... 846
Ridleia tiliæfolia ... 884
Riparia paludicola chinensis ... 912
Rita buchanani ... 984
Rœdleia truncata ... 628
Ropocichla atriceps nigrifrons ... 817
Rostratula bengalensis bengalensis ... 820
Rucervus duvaucelli ... 1060

PAGE
Rucervus thamin brucei ... 1059
——— thamin ... 1059
Salmalia malabarica ... 637
Salpornis spilonota spilonota ... 790
Salvinia ... 1002
Sarcogyps calvus ... 826, 1077
Saurida tumbil ... 990
Saxicola caprata bicolor ... 1074
——— burmanica ... 902
——— torquata ... 1074
——— indica ... 823, 927
——— leucura ... 903
——— stejnegeri ... 902
Saxicoloides fulicata fulicata ... 818
Schizea ... 999
Sciæna albida ... 976
——— aneus ... 976
——— belangeri ... 976
——— bleekeri ... 976
——— brunneus ... 984, 985
——— diacanthus ... 976, 985
——— glaucus ... 976
——— maculata ... 976
——— miles ... 976
——— ossa ... 976
——— sina ... 976
——— vogleri ... 976
Sciænoides brunneus ... 984, 985
Scirtothrips dorsalis ... 1032
Scolopax rusticola ... 827
Scolopendra sp. ... 1097
Scolopendrium ... 998
Scolothrips asura ... 1035, 1040
Scombe microlepidotus... ... 990
Scorpiops asthenurus ... 1051
——— montanus ... 1051
Scotocerca inquietus striatus ... 926
Seetzenia ... 894
——— orientalis ... 894
Seicercus xanthoschistus ... 1075
——— albosuperciliaris ... 824
Selaginella ... 992, 1002
Selenarctos tibetanus ... 1056
Selenothrips rubrocinctus ... 1034
Senra incana ... 631
Sephisa dichroa ... 837
Shorea talura ... 626
Sida acuta... ... 628
——— alba ... 628
——— alnifolia ... 628

Page
Sida carpinifolia ... 628
—— cordifolia ... 629
—— cuneifolia ... 628
—— glauca ... 630
—— glutinosa ... 628
—— graveolens ... 630
—— grewfoides ... 628
—— hirta ... 630
—— humilis ... 627
—— mysorensis ... 628
—— pannosa ... 630
—— rhombifolia... 628
———— *var.* retusa ... 629
—— rhomboidea ... 629
—— schimperiana ... 628
—— spinosa ... 628
—— urticæfolia ... 628
—— veronicaefolia ... 627
Siphia parva ... 749
———— albicilla ... 904
Sitta castaneiventris neglecta ... 669
—— frontalis ... 669, 1073
———— corallina ... 669
—— himalayensis ... 822
—— neumayeri dresseri ... 925
Siva cyanouroptera cyanouroptera ... 822
Solandra lobata ... 632
Solea ovata ... 988
Spathodea campanulata ... 716
Spatula clypeata... 931
Sphenocercus sphenurus ... 827, 1078
Spilornis cheela spilogaster ... 819
Spindasis lohita ... 833
Spirogyra adnata ... 843
———— neglecta ... 842
Spizaetus cirrhatus ceylonensis ... 819
Squatarola helvetica ... 614, 617
————squatarola ... 613
———————— hypomela ... 617
———————— squatarola .. 614
Stachyris nigriceps coltarti ... 671
———————— davisoni ... 671
———————— subsp. ... 671
Staphidia castaneiceps ... 672
Stenoloma... ...994, 995, 998
———— chinensis ... 1001
Sterculia alata ... 879
———— campanulata ... 878
———— colorata ... 879
———— fœtida ... 878
———— guttata... 878

Page
Sterculia populifolia ... 878
———— urens ... 878
———— villosa ... 878
Sterna albifrons saundersi ... 820
———————— sinensis ... 820
Stibochiana nicea ... 837
Stoparola melanops ... 1075
———————— melanops 824, 905
Streptopelia chinensis ... 1078
———————— ceylonensis ... 819
———————— suratensis ... 827
———— decaocto ... 1079
———— orientalis ... 1078
———— risoria risoria ... 934
———— senegalensis ... 1079
———————— cambaiensis 827
———— turtur arenicola ... 934
Strix indranee newarensis ... 826
—— nivicola ... 826
Stromateus cinereus ... 977, 985
———— niger ... 977
———— sinensis ... 977
Stromatopteris ... 999
Sturnia malabarica nemoricola ... 910
Sturnopastor c. superciliaris ... 910
Sturnus vulgaris ... 749
———————— poltaratskyi... 923
Suastus gremius ... 838
Surendra quercetorum ... 838
Surniculus lugubris ... 730
Suya crinigera crinigera ... 825
Sylvia communis icterops ... 926
———— curruca ... 749
———————— curruca ... 926
Synagris bleekeri ... 990
———— japonica ... 990
Synaptura commersoniana ... 988
———— cornuta ... 988
———— orientalis ... 988
———— zebra ... 988
Taccocua leschenaulti ... 819
Tachornis batassiensis ... 774
———— b. batassiensis ... 819
———— infumatus ... 774
Tadorna tadorna... 930
Tagiades atticus... 838
Tajuria diœus ... 838
———— illurgis ... 838
Targionia hypophylla ... 845
Tatera cuvieri ... 939
Telchinia violæ ... 1014

PAGE
Tephrodornis gularis pelvicus ... 906
———p. pondiceriana ... 906
Terias blanda silhetana ... 1007
——— hecabe ... 838
——— simulata ... 1007
——— læta ... 1007, 1094
——— libythea ... 1007
——— sari ormistoni ... 1007
——— venata ... 1094
——— venata ... 1007
Terpsiphone p. paradisi ... 818
Tesia cyaniventer cyaniventer ... 901
Testudo elegans ... 828
Thalasseus bengalensis bengalensis... 933
——— bergi velox ... 933
——— sandvicensis sandvicensis 933
Theobroma cacao ... 885
Thereiceryx z. zelanicus ... 819
Thespesia lampas ... 634
——— macrophylla... 634
——— populnea ... 635
Thiacidas postica ... 785
Threskiornis melanocephalus... 820
Timalia bengalensis ... 670
——— pileata intermedia ... 670
——— jerdoni ... 670
Tirdax procumbens ... 841
Todda vaddi ... 899
Todea ... 999
Totanus nebularius ... 932
——— totanus terrigonotæ ... 932
Tradescantia discolor ... 841
——— virginiana ... 841
——— zebrina ... 841
Tribulus alatus ... 894
——— terrestris ... 894
Trichomanes ... 994, 995, 998, 1001
Trichurus sp. ... 991
Tringa glareola ... 820
——— hypoleucos ... 820
——— ochropus ... 827
——— squatarola ... 614
——— stagnatilis ... 820
——— t. totanus ... 820
Triumfetta angulata ... 890
——— annua ... 890
——— bartramia ... 890
——— cana ... 889
——— indica ... 890
——— oblongata ... 889
——— pentandra ... 890

PAGE
Triumfetta pilosa ... 889
——— pseudocana... 889
——— rhomboidea... 890
——— rotundifolia... 890
——— tomentosa ... 889
——— trilocularis ... 890
Trochalopterum erythrocephalum erythrocephalum ... 822
——— lineatum ... 1073
——— griseicentior 822
Troglodytes troglodytes ... 749
Troides minos ... 1004
Tropæolum aduncum ... 900
——— majus ... 899
——— minus ... 900
——— peregrinum ... 900
Tropidonotus piscator ... 1085
——— stolatus ... 1085
Trygon bleekeri ... 974
——— khulii ... 974
——— sephen ... 974
——— uarnak ... 974
——— walga ... 974, 975
——— zugei ... 974
Tryphactothrips rutherfordi ... 1036, 1040
Turdinulus brevicaudatus striatus ... 671
Turdoides griseus striatus ... 817
——— somervillei ... 1063, 1071
Turdus albogularis ... 823
——— atrogularis ... 926
——— boulboul... 823, 1074
——— castaneus castaneus ... 823
——— merula albocinctus ... 823
Typhlops brahminus ... 1086
Tyto alba alba ... 929
Udaspes folus ... 838
Upenoides sulphureus ... 990
——— vittatus ... 990
Upupa epops epops ... 735, 826, 928, 1077
Urena lobata ... 631
——— *var.* sinuata ... 631
——— palmata ... 631
——— sinuata ... 631
Uria aalge helgolandica ... 744
Urocissa melanocephala ... 1073
——— magnirostris 668
——— occipitalis ... 822
Uroloncha malabarica ... 956
——— punctulata punctulata ... 818
——— subundulata ... 911
Uroloncha striata ... 1066

PAGE
Uroloncha striata 818
——— striata subsp. 911
Ursus malayanus 798
——— isabellinus 1056
Vanellus vanellus 933
Vanessa canace 837
——— viridis 1013
——— cardui 837, 1013
——— cashmirensis 837
——— c-album cognata 837
——— indica pholœ 1013
Vateria indica 627
Virachola isocrates 838
——— perse 838
Visenia indica 883
——— umbellata 883
Vittaria 998
Waltheria americana 637
——— indica 637
Xanthochymus ovalifolius 624
——— pictorius 624
——— spicatus 624
——— tinctorius 624
Xantholæma hæmacephala lutea ... 819
Ximenia ægyptiaca 895
——— agihalid 895

PAGE
Ximenia ferox 895
Ypthima baldus madrasa 1009
——— ceylonica 1009
——— hubneri hubneri 1009
——— sakra 837
Zamenis fasciolatus 1084
——— gracilis 1085
——— mucosus ... 1081, 1084, 1085
Zemeros flegyas 838
Zephyrus ataxus 838
——— birupa 838
——— icana 838
——— syla 838
Zetides agamemnon menides 1006
——— doson elaeius 1006
——— sarpedon teredon 1006
Zipœtis saitis 1009
Zoothera marginata 904
Zosterops palpebrosa 1076
——— elwesi 825
——— palpebrosa ... 915
——— simplex peguensis 915
Zygnema sp. 843
Zygæna 989
Zygophyllum coccineum 895
——— simplex 895

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Fields-Clarke, V. H. T. (I.F.S.)	Rangoon.
Fletcher, Thos. Bainbrigge (F.E.S.)	Pusa.
Florence, James	Kievcote.
Flynn, A. A. (C.M.Z.S.)	Karachi.
Fooks, H. A.	Calcutta.
Forrington, A.	Bombay.
Forsyth, Dr. Wm.	Edinburgh.
Foster, Lt.-Col. Rodney (I.A.)	Maymyo.
Foulkes, R.	Madura.
Foulkes, Lt.-Col. T. H. (I.M.S.) (*Life Member*)	Europe.
Fountaine, Miss Margaret (F.E.S.)	London.
Fraser, Duncan	,,
Fraser, Lt.-Col. F. C. (I.M.S., M.D., F.L.E.S.)	Coimbatore.
Fraser, J. S.	London.
Fraser, Major S. G. G.	Bombay.
Fraser, Sir Stuart (I.C.S., K.C.S.I., C.I.E.)	,,
Frederickson, H.	Beccles, England.
Frei, Max (*Life Member*)	Zurich, Switzerland.
Freke, C. G. (I.C.S.)	Bombay.
Frenchman, D. P. (B.SC.)	Gandamanayakanur.
Frend, G. V. R.	Balehonur.
Frere, Lt.-Col. A. G. (I.A., F.Z.S.) (*Life Member*)	Coimbatore.
Gairdner, K. G.	Lakon, Lampang.
Gallant, M. N. (B.SC., I.F.S.)	London.
Game Secretary, The	Gilgit.
Gamlen, R. L.	Hyderabad, Dn.
Gammie, Prof. G. A. (*Life Member*)	London.
Garbett, C. C. (I.C.S.)	Lahore.
Gauripur, Raja Prabhatchandra Barna (*Life Member*).	Gauripur.
Gaye, W. C.	Arlington.
Gee, E. P.	Golaghat.
Gentle, J. A. R. (I.F.S.)	Mandla.
Geoghegan, Mrs. O. A.	Simla.
George, Hugh S. (I.F.S.)	Betul.
Gharpurey, Lt.-Col. K. G. (I.M.S.) (*Life Member*)	Ahmednagar.
Gibson, E. C. (I.C.S.)	Ajmer.
Gilbert, C. E. L. (I.F.S.)	Karachi.
Gilbert, T.	Europe.
Gill, E. H. N. (F.Z.S.)	Budaun.
Gill, H. E. P.	London.
Gillespie, Major F. S. (M.D., R.A.M.C.)	Wellington.
Gimson, C. (I.C.S.)	Sylhet.
Girsperger, F.	Bombay.
Gladstone, Capt. H. S. (F.Z.S., F.R.S.E.)	Capenoch, Scotland.
Gladstone-Solomon, Capt. W. E. (I.E.S.)	Bombay.
Glass, E. L.	Ranchi.
Glennie, Major E. A. (D.S.O., R.E.)	Mussoorie.
Glover, H. M.	London.
Godfrey, E. J. (B.SC.)	Bangkok.
Goldie, Dr. E. A. (M.C., I.M.S.)	Lahoaal, Assm.

Gondal, Kumar Shree Nutversinhji	Jetalsar
Gonsalves, A. F. (*Life Member*)	Bandra.
Goord, T. D.	Baghdad.
Gordon, F. W. (M.C., M.A. (OXON) I.F.S.)	Lonmay.
Gordon, Major J. W.	Jodhpur.
Gordon, R G. (I.C.S.)	Nasik.
Gore, F. W.	England.
Gothorp, Percy	Assam.

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Director of Agriculture, Bombay	Poona.
Director, Bureau of Science	Manila.
Director of Agriculture, B. & O.	Sabour.
Director of Agriculture, Punjab	Lahore.
Gould, B. J. (C.I.E., I.C.S.)	London.
Gouldbury, C. P.	Mattupatti.
Gow, Cedric J.	Madras.
Graham, A. A.	Rawalpindi.
Graham, Sir L. (C.I.E., I.C.S., K.C.I.E.)	London.
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Grant, F. A.	London.
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Graves, Mrs. D. J.	London.
Greaves, J. B.	,,
Green, E. Ernest (F.E.S.)	Camberley-England.
Green, M. M.	Ardmore, U.S.A.
Gregory-Smith, Capt. H. G. (*Life Member*)	London.
Gregson, T. S.	Bombay.
Grennan, E. W.	Belgaum.
Grieve, R. G. (M.A., C.I.E., I.E.S.)	Madras.
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Grose, F. S.	Myitkyina.
Gulamkadir, Md. Shahban	Shikarpur.
Guthrie-Smith, F. J.	Meerut.
Guzder, H. B.	Bombay.
Hakro, Khan Saheb Haji Ali Hassan	Larkana.
Hamber, Capt. L. G. W.	Dharamsala, Cantt.
Hamid, A. Ali (I.C.S.) (*Life Member*)	Alibag.
Hamid Khan, M. (M.SC., LL.B.)	Lahore.
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Hance, Major J. B. (O.B.E., I.M.S.)	Bombay.
Hancock, Major C. P.	Ajmer.
Hanhart, S.	Bombay.
Hare, Brigadier G. A. (R.A.)	Kirkee.
Harman, A. C.	Bettiah.
Harper, Lt.-Col. A. Forrest	London.
Harper, William	,,
Harris, W. (M.R.C.V.S.)	Gauhati.
Harris, Jr., Wm. P. (*Life Member*)	Michigan, U.S.A.

Harrison, Mrs. H. Z.	Bombay.
Hartigan, Capt. G. E. R. S. (M.C.)	Lansdowne.
Hartnoll, E. S. (I.F.S.)	Bhamo.
Harvey, Capt. C. W. L. (M.C.)	Imphal.
Hasted, Capt. J. S. H.	Dehra Dun.
Hastings, J. R. G.	London.
Haswell, Capt. F. W. (I.A.)	,,
Hâte, Prof. Vinayakrao N. (B.SC.)	Bombay.
Haughton, Lt.-Col. H. L. (C.I.E.)	,,
Hawes, C. G.	,,
Hay, Major R. (I.M.S.)	Dera Ismail Khan.
Hayes, A.	Rangoon.
Heaney, Capt. G. F. (R.E.)	Maymyo.
Hearsey, Capt. L. D. W. (M.C., V.D.)	Kheri.
Hector, G. P. (M.E., D.SC.)	Dacca.
Heilner, Van Campen (M.SC., F.R.G.S., F.R.A.I.)	New Jersey.
Henderson, Alexander	Bombay.
Henderson, J. L.	Quilon.
Hennessy, Major J. M. R. (I.M.S.)	Jubbulpore.
Heron, F. A. T.	Europe.
Hewetson, C. E. (I.F.S.)	Bombay.
Hicke, Major F. C.	Quetta.
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Hickin, S. B.	Sukkur.
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Higginbottom, Dr. Sam	Allahabad.
Higgins, J. C. (I.C.S.)	Imphal.
Hiley, A. C. (I.F.S.)	Poona.
Hill, K. A. L. (I.C.S.)	Calcutta.
Hill, Major R. D. O. (*Life Member*)	London.
Hillyer, R. A. N.	Siam.
Hingston, Major R. W. G. (I.M.S.)	London.
Hislop, Major J. H. (M.C., I.M.S.)	,,
Hodgson, R. C.	Colombo.
Holmes, H. R.	England.
Hopkinson, A. J. (I.C.S.)	Abbottabad.
Hopwood, S. F. (I.F.S.) (*Life Member*)	Rangoon.
Hora, Dr. Sunder Lal (D.SC.)	Calcutta.
Horner, Capt. B. Stuart	London.
Horst, W. (I.S.E.)	Bhimnagar.
Horticulturist, Municipal Gardens, The	Karachi.
Hoshang, N. E. Dinshaw	,,
Hotson, Sir Ernest (K.C.S.I., O.B.E., I.C.S.) (*Life Member*)	Bombay.
Hotz, E.	Agra.
Howard-Bradshaw, Lt.-Comdt. C. T. (R.N.)	Lifton.
Howe, P. A. W.	Pyinmana.
Howell, E. Berkley (C.I.E., I.C.S.)	Simla.
Howitt, Capt. J. F. G.	London.
Hoyos, Count E. (*Life Member*)	Austria.
Hudson, Major-Genl. Corrie (C.B., C.I.E., D.S.O., K.H.S., I.M.S.)	Naini Tal.

Hudson, Sir Leslie (*Kt.*)	London.
Huggins, J. R.	Sunningdale.
Hughes, A. R.	Colombo.
Hughes-Hallet, Capt. N. M.	Shrewsbury.
Hundley, G.	London.
Hunt, L. E.	Calcutta.
Husbands, Major H. W. S. (M.C., A.M.I.C.E., S.M.R.E.) (*Life Member*)	London.
Hutchinson, Lt.-Col. L. T. Rose (I.M.S.)	Bombay.
Hutchinson, Lt.-Col. W. Gordon (I.A., O.B.E.)	London.
Hutchison, L. P.	Azamgarh.
Hutton, C. H.	England.
Hutton, C. I.	Insein.
Hyam, Khan Bahadur Judah (G.B.V.C., F.Z.S.) (*Life Member*)	Poona.
Ibbotson, Capt. A. W. (M.C., M.B.E., I.C.S.)	Pauri.
Ichalkaranji, The Hon'ble Meherban Narayan Govind *alias* Babasaheb Ghorpade (*Life Member*)	Ichalkaranji.
Idar, H. H. Maharajashri Himmat Singhji Sahib Bahadur (*Life Member*)	Himatnagar.
Imperial Council of Agricultural Research	New Delhi.
Inder, R. W. (I.F.S.)	Poona.
Indore, H.H. Tukojirao Holkar (*Life Member*)	Indore.
Indore, H. H. The Maharaja Yeshwantrao Holkar (*Life Member*)	,,
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Inglis, Chas. M. (F.Z.S., M.B.O.U.) (*Life Member*)	Darjeeling.
Inglis, C. C.	Poona.
Irvine, A. E.	Ootacamund.
Irwin, Lord (P.C., G.M.S.I., G.M.I.E.)	London.
Irwin, Major H. R. (I.A.S.C.)	Bombay.
Isaacs, Miss Mozelle (M.A., M.Sc.)	Dombivli.
Ishwardas Lukhmidas	Bombay.
Ivens, J. H. (P.W.D.) (*Life Member*)	Europe.
Jackets, C. H.	Royapetta.
Jackson, Dr. T. S.	London.
James, Lt.-Col. F. H.	Bombay.
Jamkhandi, Shrimant Shankarrao Parashuramrao *alias* Appasaheb Patwardhan (K.C.I.E.) (*Life Member*)	Jamkhandi.
Jamsetji, M. Doctor (F.Z.S., C.M.Z.S)	Bombay.
Jardine, W. E. (C.I.E., I.C.S.)	London.
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Jatia, Sir Onkar Mull (*Kt.*, O.B.E.)	Calcutta.
Jeff, R.	Linthouse.
Jenkin, R. Trevor (I.F.S.)	Chanda.
Jermyn, Lt. R. O.	Bombay.
Jhalawar, H. H. The Maharaja Rana Rajendra Singh Bahadur	Jhalrapatan.
Jind, H. H. The Maharaja Sir Ranbir Singh (K.C.S.I., G.C.I.E.) (*Life Member*)	Jind

Jodhpur, Lt.-Col. H.H. The Maharaja Sir Umaidsingh Bahadur (K.C.S.I., K.C.V.O., G.C.I.E.) (*Life Member and Vice-Patron*)	Jodhpur.
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Johnson, Capt. A.	Trimulgherry.
Johnson, Kay	Moran.
Jones, A. E.	Simla.
Jones, A. J. (I.P.)	Rangoon.
Jones, Capt. N. J. G.	Razmak.
Jones, Capt. W. H. C.	Europe.
Jones, Major W. E.	Bombay.
Jourdain, Rev. F. C. R.	England.
Jukes, Hon'ble Mr. J. E. C. (C.I.E., I.C.S.)	Reigate.
Junagadh, His Highness the Nawab of	Junagadh.
Kaiser Shumsher Jung Bahadur Rana, S. M. Lt.-Genl. (*Life Member*)	Nepal.
Kanga, Miss P. M. (M.SC.)	Bombay.
Karachi, Victoria Museum, The Curator	Karachi.
Katrak, N. N.	Bombay.
Kazi, E. D. (J.P.)	,,
Keays, Lt.-Col. R. W. C. (I.A.)	Madras.
Keily, H. G.	Bombay.
Keip, Oscar	,,
Kemp, W. N. R.	Peeprah.
Kempe, J. E.	Klang.
Kennion, Lt.-Col. R. L. (F.Z.S., C.I.E.)	England.
Kermode, C. W. D. (I.F.S.)	London.
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Khairpur, H. H. Mir Ali Nawazkhan (*Life Member*)	Khairpur.
Khan, Sahebzada Sardar Mahomed	Karachi.
Khanolkar, Dr. Vasant R. (B.SC., M.D.)	Bombay.
Khareghat, M. P. (I.C.S.)	,,
Khetri, Raja Sardar Singh Bahadur (*Life Member*)	Khetri.
Khilchipur, H. H. Durjansal Singh (*Life Member*)	Khilchipur.
Kiddle, J. A. C.	Moulmein.
Kiernander, Major O. G.	Iraq.
Kilburne, R. G.	Nepal.
King, E. O. (I.A.R.O.)	Kodaikanal.
King, Lt.-Col. J. St. Aubyn	London.
Kinloch, Mrs. A. M.	Kotagiri.
Kirby, R. R.	Tindharia.
Kirk-Greene, Mrs. Leslie (*Life Member*)	London.
Kirwan, Noel G. B.	Mangalore.
Knight, H. F. (I.C.S.)	Bombay.
Knight, L. G.	Kalthuritty.
Koechlin, E. L.	Pykara.
Koechlin, M. C.	Munnar.
Kolhapur, H. H. The Maharaja Lt.-Col. Sir Rajaram Chhatrapati (G.C.I.E.) (*Life Member*)	Kolhapur.
Kotah, H. H. The Maharajadhiraj Lt.-Col. Sir Umed Singhji Saheb Bahadur (G.C.S.I., G.C.I.E., C.B.E.) (*Life Member*)	Kotah.

Kothare, A. K.	Bombay.
Kothavala, T. T.	Surat.
Krishnalal, Capt. (D.R.T.C., M.I.E. & S., A.F.R.A.S.)	Indore.
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Kydd, D.	London.
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Laidlay, J. C.	Scotland.
Lakshminarayanan, C.	Madras.
Lalljee, Hooseinbhoy A.	Bombay.
Lamb, Thos.	Calcutta.
Lambert, Hon'ble Sir George (K.C.S.I., I.C.S.)	Naini Tal.
Lampard, L. A.	Quilon.
Landells, W. J.	Tamok.
Lane, H. S.	Bangalore.
Latham, H. D.	Vellore.
Latif, Hasan (M.I.E., A.M.I.E.E.)	Hanamkonda.
Latif, Sarhan C.	Karachi.
La Touche, J. F. D.	Rangoon.
Laud, D. S.	Bombay.
Laughton, Capt. F. E. (I.A.)	,,
Laurie, M. V. (I.F.S.)	Madras.
Laws, Wilfred	Teok.
Lawther, B. C. A. (C.I.E.)	Peshawar.
Leach, A. H. L.	Rangoon.
Lee, D. H. (*Life Member*)	Europe.
Lee, Capt. G. H. (M.C.)	Raipur.
Leech, Mrs. A. J.	Kodaikanal.
Lees, L. M. (I.C.S.)	Rangoon.
LeMarchand, A. E. M.	Europe.
LeMarchand, W. M.	Dibrugarh.
Leonard, D. G.	Cawnpore.
Leonard, Lt.-Col. W. H. (I.M.S.)	Bombay.
Leonard, P. M. R. (O.B.E.)	Rangoon.
Levett, R. W.	Ootacamund
Lewis, J. Spedan (*Life Member*)	London.
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Benares, Hindu University Library, The Librarian	Benares.
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Hyderabad, The Librarian, State Library	Hyderabad, Dn.
Imperial Library, The Librarian	Calcutta.
Lahore, University of Punjab, The Librarian	Lahore.
Lucknow University Library	Lucknow.
Madras, Connemara Public Library, The Principal Librarian	Madras.
Neilson Hays Library	Bangkok.
Nilgiri Library, The Honorary Secretary	Ootacamund.

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United Service Library, The Honorary Secretary	Poona.
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Lightfoot, Capt. G. S. (I.P.)	Assam.
Lightfoot, S. St. C.	Taunggyi.
Limbdi, H. H. Maharana Shri Sir Daulatsinhjee (K.C.I.E.)	Limbdi.
Limbdi, The Yuvaraj Saheb of	,,
Lindberg, K.	Kurduwadi.
Lindley-Hinde, G.	Calcutta.
Lister, R. S.	Ghoom, Bengal.
Little, E.	Kirkee, Poona.
Locket, A.	Numaligarh.
Lodge, G. E.	England.
Logan-Home, Major W. M.	,,
Long, G. R. (I.F.S.) (*Life Member*)	,,
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Lorimer, Major D. L. R. (C.I.E., I.A.) (*Life Member*).	London.
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Lowndes, Capt. D. G. (*Life Member*)	Razmak.
Lowndes, R. C.	Bombay.
Lowsley, C. O.	Karachi.
Lowther, E. H. N. (F.I.S., M.B.O.U.)	London.
Lucknow, Provincial Museum, The Curator	Lucknow.
Ludlow, F. (M.A., M.B.O.U., I.E.S., O.B.E.) (*Life Member*)	Srinagar.
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Lunham, Lt.-Col. J. L. (I.M.S.)	Bombay.
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Macdonell, J. F.	Bombay.
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Mackenzie, Wm.	Udamalpet.
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Mackie, Bt.-Col. F. P. (I.M.S., O.B.E., K.H.S.)	Shillong.
Mackinlay, Lt.-Col. Chas.	Edinburgh.
Mackwood, F. E.	Colombo.
Mackwood, F. M.	,,

MacLachlan, Capt. D.	Bombay.
MacLachlan, R. B.	Karachi.
Macleod, A. (I.C.S.)	Bournemouth.
Macleod, Lt. A. J. W.	London.
Macleod, R. D. (I.C.S.)	Etawah.
MacMichael, N. (C.S.I., I.C.S.)	London.
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Macnaught, W. E.	Perak.
Macqueen, H. C.	Dehra Dun.
Madan, F. R. (I.F.S.)	Ootacamund.
Madras, H. E. the Governor	Madras.
Mahendra, B. C. (M.SC.)	Agra.
Mahon, Col. A. E.	Kulu.
Main, T. F. (B.SC.)	Poona.
Major, R.	Patoree.
Malcolm, C. A. (C.I.E., I.F.S.)	Nagpur.
Maltby, Major C. M. (I.A., M.C.)	Simla.
Manavadar, Khan Shree Fatehdinhan (*Life Member*).	Manavadar.
Mandlik, Narayan V. (*Life Member*)	Bombay.
Mangrol, The Shaikh Saheb of (*Life Member*)	Mangrol.
Mann, Dr. H. H. (D.SC.)	Poona.
Maricar, B. E.	Tavoy.
Marjoribanks, Sir Norman (K.C.I.E., C.S.I., I.C.S.)	Madras.
Marques, Dr. F. B.	Goa.
Marshall, Arch. McL. (*Life Member*)	England.
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Marshall, Mrs. H. A.	Travancore.
Marshall, J. McL. (*Life Member*)	Scotland.
Marshall, Brig.-Genl. T. E. (R.A.)	N. Wales.
Martin, Col. Gerald (*Life Member*)	London.
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Martin, S. J.	London.
Marzban, K. B.	Bombay.
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Maxwell, M. (*Life Member*)	London.
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McConaghy, Lt.-Col. C. B. (I.M.S.) (*Life Member*)	Camberley.
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McLeod, Lt.-Col. D. K.	Mardan.
McMahon Museum, The Honorary Secretary	Quetta.
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Measham, Dr. J. E. (M.D.)	Valparai.
Mehta, H. M.	Bombay.
Mehta, J. N. R.	Karachi.
Meinertzhagen, Lt.-Col. R.	London.
Menezes, J. Hector	Goa.
Merrikin, M. S.	Rangoon.
Methold, J. H.	Calcutta.

Millard, A. W. P. (*Life Member*)	London.
Millard, W. S. (F.Z.S.) (*Life Member*)	,,
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Miller, John I. (F.R.G.S., F.Z.S.)	Calcutta.
Miller, Lt. R. O.	Murree.
Mills, Major J. D. (*Life Member*)	England.
Mills, J. P. (I.C.S.)	Calcutta.
Milner, C. E.	Rangoon.
Milroy, A. J. W.	Shillong.
Minchin, A. A. F. (I.F.S.)	Bellary.
Miraj, Shrimant Sir Gungadhar Rao Ganesh *alias* Babasaheb Patwardhan (K.C.I.E.) (*Life Member*).	Miraj.
Mirchandani, Tolo K. (B.E., A.M.I.E., B.F.S.)	Dharwar.
Mirchandani, U. M. (I.C.S.)	Thana.
Mitchell, Lt. E. D. Treneer	London.
Mitchell, F. J.	Lahore.
Mitchell, H. H. G. (*Life Member*)	London.
Mitchell, Capt. R. S. J. (R.E.)	Europe.
Modi, Sir Jivanji Jamshetji (*Kt.*) (B.A., Ph.D., C.I.E., J.P.)	Bombay.
Mohomed Raza Ebrahim	Mergui.
Mohr, Dr. V. der Meer	Medan, Sumatra.
Moloney, W. J.	Bombay.
Montagnon, D. J. (*Life Member*)	Dibrugarh.
Monte, Dr. D. A. de (L.M. & S.)	Bandra.
Monteath, G. (I.C.S.) (*Life Member*)	Belgaum.
Monteath, J. (I.C.S.)	Karachi.
Montmorency, H. E. Sir Geoffrey (K.C.V.O., K.C.I.E., C.B.E., I.C.S.)	Punjab.
Mooney, H. F. (I.F.S.)	Hinoo.
Moore, Capt. A C. (I.A.)	Rangoon.
Moore, G. D.	Bombay.
Moore, J.	London.
Morden, W. J.	U. S. A.
Morgan, Major J. S. H.	Sidapur.
Morgan, R. W. D.	Calcutta.
Morison, Lt.-Col. John (I.M.S.)	Rangoon.
Morris, Chas. W. G.	Attikan.
Morris, Lt.-Col. D. O. (*Life Member*)	London.
Morris, R. C. (F.Z.S., F.R.G.S.)	Attikan.
Morton, Geo. B.	Calcutta.
Morvi, H. H. The Maharaja Lakhdiriji Waghji (K.C.S.I.) (*Life Member*)	Morvi.
Mosse, Lt.-Col. A. H. E. (I.A.) (*Life Member*)	Bhavnagar.
Mott, John L.	New York City.
Mudhol, Shirmant Sir Malojirao Raje Ghorpade (K.C.I.E.)	Mudhol.
Mueller, Dr. H. C. (D.Sc.)	Bombay.
Mulroney, J. T.	Kurseong.
Mundy, N. S.	Silchar.
Munns, F. A. C.	Turkaulia.
Murland, Lt.-Col. H. F. (*Life Member*)	Suntikoppa.

Murphy, P. J.	Ramna, Dacca.
Mursell, D. F.	London.
Musgrave-Hanna, Capt. J. R.	Fort Sandeman.
Mysore, The Director of Agriculture	Bangalore.
Mysore, Government Museum, The Superintendent	,,
Mysore, H. H. The Maharaja Sir Krishnaraj Woodayar Bahadur (G.C.S.I., G.B.E.) (*Life Member*)	Mysore.
Nagpur, Central Museum, The Curator	Nagpur.
Namjoshi, V. K. (*Life Member*)	Bombay.
Naraenji Dwarkadas (*Life Member*)	,,
Narayanlal Bansilal, Raja (*Life Member*)	,,
Narsingarh, H. H. Raja Vikram Singhji Saheb Bahadur	Narsingarh.
Nash, H. J.	Ajmer.
Nawanagar, H. H. The Jam Saheb (K.C.S.I., C.B.E.) (*Life Member*)	Jamnagar.
Neal, Dr. W. L. (I.M.S.)	Gyantse.
Neathan, A. P.	Bombay.
Needham, F. M.	Murkong-Sellek.
Nehru, Dr. S. S. (Ph.D., M.A., LL.D., I.C.S.)	Lucknow.
Nepal, Supradipta Manyaber General Mohun Sumshere Jung Bahadur Rana (K.C.I.E.) (*Life Member*)	Nepal.
Nevill, Capt. T. N. C.	London.
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Newland, Lt.-Col. B. E. M. (I.M.S.)	Bareilly.
Newman, T. H. (F.Z.S., M.B.O.U.)	London.
Nicholetts, W. A. B.	Rangajan.
Nicholson, Lt.-Col. F. L. (D.S.O., M.C.)	Quetta.
Nicholson, Lt.-Col. M. A. (I.M.S.)	Bombay.
Niederer, George	,,
Nilgiri Game Association	Ootacamund.
Norman, Col. H. H. (R.A.M.C.)	London.
Norris, J. P.	U. S. A.
Norton, Col. E. F. (M.C., D.S.O.)	Quetta.
Nougerede, L. J. de la	Sadiya.
Noyce, Sir Frank (I.C.S.) *Kt.* (*Life Member*)	London.
Nurse, Lt.-Col. C. G. (F.E.S.) (*Life Member*)	England.
Oberholser, Harry C. (*Life Member*)	Washington, D. C.
O'Brien, Lt.-Col. Edward (C.B.E.)	Bombay.
O'Brien, H. C.	London.
O'Callaghan, T. P. M.	Sadiya.
O'Donel, H. V.	Binnaguri.
O'Donnell, C. O.	U. S. A.
O'Donovan, Capt. M. J. W.	Agra.
Ogilvie, G. H. (I.F.S.) (*Life Member*)	Rangoon.
O'Grady, W. J.	Thomog.
Oldfield, A. V.	Bombay.
Olivares, Senor Luis de	Lista 7, Spain.
Oliver, A. W. L.	Shanghai.
Olivier, Col. H. D. (R.A., F.Z.S.) (*Life Member*)	Winchfield, England.
Ollenbach, O. C. (F.E.S.)	Mussoorie.

Ormiston, W.	Haldummulle, Ceylon.
O'Rorke, Major J. M. W.	London.
Osborne, A. F.	Tuticorin
Osborne-Jones, M. T.	Tanjore.
Osmaston, A. E. (I.F.S.)	Dehra Dun.
Osmaston, B. B. (C.I.E., I.F.S.)	Oxford.
Osmaston, F. C. (I.F.S.)	Sambalpur.
Page, A. J. (I.C.S.) (*Life Member*)	London.
Palanpur, H. H. Sir Nawab Saheb Taley Mahomed, Khan Bahadur (K.C.I.E., K.C.V.O.)	Palanpur.
Palitana, H. H. The Thakur Saheb Bahadur Sinhji (K.C.I.E.) (*Life Member*)	Palitana.
Palmer, W. L.	Kalaw.
Palmes, W. T. (I.C.S.)	Minbu.
Panday, Mrs. J. L.	Bombay.
Parker, H. (I.C.S.)	Rangoon.
Parlakimedi, Sri Sri Sri Krishnachandra Gajapati Narayen Deo (*Life Member*)	Parlakimedi.
Parlett, L. M. (I.C.S.) (*Life Member*)	England.
Parry, N. E. (I.C.S.)	London.
Paterson, E. A.	Calcutta.
Paterson, T. R.	Neora.
Patiala, H. H. The Maharaja Sir Bhupendra Singh (G.C.S.I., G.C.I.E., G.C.B.E.) (*Life Member*)	Patiala.
Patiala, Capt. Rao Raja Birindra Singhji (*Life Member*)	,,
Patiala, H.H. The Maharaj Kumar Brijindra Singhji	,,
Patten, Hugo J.	Edinburgh.
Patterson, A.	London.
Pattison, R.	Bombay.
Patuck, P. S. (I.C.S.) (*Life Member*)	London.
Pawsey, C. R. (I.C.S.)	Makokchung.
Pazze, Peter P.	Bombay.
Peacock, E. H. (B.F.S.) (*Life Member*)	Mawlaik.
Peck, Mrs. L. J.	Simla.
Peebles, W. J. M.	London.
Peet, Major L. M.	Poona.
Peppe, Capt. F. H. (R.A.)	Basti.
Percival, A. P. (I.F.S.)	England.
Perfect, E.	Guntakal.
Pershouse, Major Stanley	London.
Pestonji Jivanji (N.C.S.) (*Life Member*)	Hyderabad, Dn.
Petit, Dhunjibhoy Bomanji (*Life Member*)	Bombay.
Petit, Jehangir Bomanji (*Life Member*)	,,
Petit, S. C. D.	,,
Petit, F. C.	,,
Petley, C. A.	Toungoo.
Phayre, Lt.-Col. R. B. (M.C.)	London.
Phillips, A. A. (I.S.R.)	England.
Phillips, Charles H.	Suffry.
Phillips, W. W. A.	Gammaduwa.

Phipson, H. M. (F.Z.S.) (*Life Member*)	London.
Phythian-Adams, Major E. G. (I.A., F.Z.S.)	Mysore.
Pinhey, Capt. L. A. G.	Ziarat.
Pipe, T. S.	Karachi.
Pirpur, Raja Syed Mohommad Mehdi	Pirpur.
Pitman, Major C. R. S.	England.
Pizey, R. M.	Gohpur.
Pogson, Major F. V.	Bombay.
Poncins, Viscount Edmund de (*Life Member*)	France.
Pope, J. A. (C.I.E., I.C.S.)	Indore.
Popper, R. E.	Bombay.
Porbandar, H. H. The Maharaja Shri Natwarsinghji Bhavsinghji Rana Saheb (*Life Member*)	Porbandar.
Porteous, A. B.	Bhilad.
Poulton, Capt. H. M.	Sibi.
Prendargast, H. V.	Cawnpore.
Procter, Miss Joan B. (F.Z.S.)	London.
Puckle, Capt. H.	Ambala.
Pudukottai, State Museum, The Curator	Pudukottai.
Pullan, A. U.	Matelli.
Purkis, F. C. (B.F.S.)	Kiminini.
Purkis, H. Vernon	Wazirabad.
Purvis, J. L. F.	Mergui.
Quarry, P. S.	Dehra Dun.
Radhanpur, H. H. Shri Jalaluddin Khanji (*Life Member*)	Radhanpur.
Rae, Lt.-Col. M. E. (I.A.) (*Life Member*)	Edinburgh.
Ragg, H. A.	Munnar.
Raitt, W. Chas.	Kutta.
Rajadhyaksha, G. S. (I.C.S.)	Bombay.
Rajgarh, H. H. Raja Rawat Sir Birendra Singh (K.C.I.E.) (*Life Member*)	Rajgarh.
Ralston, Lt.-Col. W. H. (D.S.O., I.A.)	London.
Rane, K. R. (M.M. and S.P.)	Andheri.
Ranicar, E. E.	Valparai.
Ravenshaw, Col. C. W. (*Life Member*)	London.
Readymoney, N. J.	Bombay.
Rees, H. N.	Tavoy.
Rees, R.	Mazbat.

REGIMENTAL OFFICERS' MESSES—

The Royal	Trimulghery.
Royal Irish Fusiliers	Agra.
Small Arms School	Ahmednagar.
1st Bn. The Worcestershire Regiment	Meerut.
1st King's Shropshire	Poona.
6th D. C. O. Lancers	Meerut.
2nd Lancers (G.H.)	,,
Queen Victoria's Own Madras Sappers and Miners.	Bangalore.
1/6th Rajputana Rifles	Razmak.
3/6th Rajputana Rifles	Landi Kotal.
4th Bn. 6th Rajputana Rifles (Outrams)	Mhow.

REGIMENTAL OFFICERS' MESSES—*continued.*	
5th Bn. 6th Rajputana Rifles (Napiers)	Aurangabad.
1st Royal Bn. 9th Jat. Regt. L.I.	Fyzabad.
6/13th Royal F. F. Rifles	Delhi.
3/15th Punjab Regiment	Allahabad.
3/17th Dogra Regiment (Semi-*Life Member*)	Alipore.
1st North Staffordshire Regiment	Nasirabad.
2nd K. E. O. Gurkhas	Dehra Dun.
1/10th Gurkha Rifles (Semi-*Life Member*)	Fort Sandeman.
1st Bn. Rifle Brigade	Jullunder.
60th Rifles	Lucknow.
1/7th Rajput Regiment	Peshawar.
Reid, E. C.	Bombay.
Reid, Mrs. D. W. (*Life Member*)	,,
Reuben, D. E. (I.C.S.)	Cuttack.
Rewa, H. H. The Maharaja Gulabsingh Bahadur (K.C.S.I.) (*Life Member and Vice-Patron*)	Rewa.
Reynolds, Hon'ble Sir L. W. (K.C.S.I., C.I.E., C.S.I., I.C.S.)	Ajmer.
Ribeiro, J. (L.C.E.) (*Life Member*)	Santa Cruz.
Richards, B. D. (B.SC.)	England.
Riches, F. C.	Rydak.
Richmond, R. D (I.F.S.)	Madras.
Ridland, J. G.	Bombay.
Rishworth, Dr. H. R. (I.M.S.)	Jhansi.
Ritchie, Lt.-Col. W. D. (I.M.S.)	Tezpur.
Roberts, Dr. C. L. Digby	Mariani, Assam.
Roberts, Major F. C. (V.C., D.S.O., M.C.)	Baghdad.
Robertson, Lawrence (C.S.I., I.C.S.)	England.
Robertson, S. D.	Porbunder.
Robinson, A. C.	Bedford.
Robinson, G. C.	Manantoddy.
Robinson, Capt. J. A.	Bannu.
Robinson, Mrs. R. B.	London.
Rodger, Sir Alexander (I.F.S., O.B.E.)	,,
Rogers, C. G. (I.F.S.)	,,
Rogers, Rev. K. St. A. (C.M.S.)	Nairobi.
Rondano, Rev. A. (S.J.)	Kodialboil.
Roosevelt, Kermit (*Life Member*)	New York.
Roosevelt, Col. Theodore (*Life Member*)	,,
Roper, Lt. J. R. Stockley (R.A.)	Peshawar.
Ross, Lt.-Col. E. J.	Dehra Dun.
Ross, Major Tyrell (*Life Member*)	England.
Roumania, H. M. King of (*Life Member*)	Roumania.
Row, Dr. R. (M.D.)	Bombay.
Rowland, J. W. (I.P.)	Belgaum.
Rowson, W. S.	Vandi-Periyar.
Roy, M. H. Trevor	London.
Rubie, C. B.	Karachi.
Runciman, Rev. J. W.	Udaipur.
Russell, Lt.-Col. G. H. (C.I.E., D.S.O.)	Peshawar.
Rustomjee, Miss Sherene B.	Bombay.

Ruttledge, Capt. R. F. (M.C.)	Peshawar.
Sanders, Major C. W. (*Life Member*)	Kamptee.
Sanders, D. F.	Cawnpore.
Sanderson, Henry	New York.
Sanderson, P. M. D. (F.Z.S.)	Bombay.
Sangli, Meherban Sir Shrimant Chintamanrao Appasaheb Patwardhan (K.C.S.I.) (*Life Member*)	Sangli.
Sant, Maharana Shri Jarwar Singji, Raja Saheb of	Sant-Rampur.
Sarangarh, Raja Bahadur Jawahir Singh	Sarangarh.
Sarawak Museum, The Curator	Kuching.
Sarma, M. R. Venkatarama	Aduturai.
Satya Churn Law, Dr. (M.A., B.L., Ph.D., F.Z.S., M.B.O.U.	Calcutta.
Saunders, Lt.-Col. F. W. (R.E.)	London.
Saunders, H. F.	Madras.
Saunders, J. A. (I.C.S.)	Patna.
Saunders, L. (I.P.)	Chittoor.
Savantwadi, H. H. The Sardesai	Savantwadi.
Savile, Sir Leopold (C.B.) (*Life Member*)	London.
Sawyer, H. H.	Bombay.
Schmid, W. (*Life Member*)	Kreuzlingen.
Schomberg, Lt.-Col. R. C. F. (D.S.O.)	Herefordshire.
Scott, A. G. (I.P.)	Jubbulpore.
Scott, C. W. (I.F.S.)	Rangoon.
Scott, Major F. B. (I.A.)	Simla.
Scott, J. Ramsay	Cawnpore.
Scott, R. L. (*Life Member*)	Greenock.
Scroope, Major C. F.	London.
Searight, Capt. E. E. G. L. (M.C., R.E.)	Mandalay.
Seaton, E. A. (I.F.S.)	Mogok.
Secretary for Agriculture, S. S. and F.M.S.	Kuala Lumpur.
Seervai, Dr. Rustom F.	Bombay.
Sethna, C. B.	,,
Seton-Karr, Capt. H. W. (*Life Member*)	London.
Sevastopulo, D. G. (F.E.S.)	Calcutta.
Seymour-Sewell, Lt.-Col. R. B. (I.M.S.)	,,
Shah, Major B. (I.M.S.)	Belgaum.
Shanks, A. D.	London.
Shannon, G. C. (I.C.S.)	Rajkot.
Sharif, M. (M.Sc., F.R.M.S.)	Quetta.
Shaw, G. E.	Riyang.
Shaw, G. L.	Weaverham.
Shaw, John (B.F.S.)	Hsipaw.
Shebbeare, E. O.	Darjeeling.
Shephard, T. F. G.	Bombay.
Sheppard, S. T.	,,
Sherred, P. R.	Ramgarh.
Sherriff, Capt. George (R.A.)	Srinagar.
Shipp, G. W. I.	Glasgow.
Shiriey, G. S.	Rangoon.
Shortt, Major H. E. (I.M.S.)	Bombay.
Shortt, W. H. O.	Calcutta.

Shoveller, H. L. (A.C.A.)	Bombay.
Simmonds, A.	Dimakusi.
Simmons, R. M.	Ahmedabad.
Simonds, Major M. H.	England.
Sinari, Dr. V. R. P.	Goa.
Sitwell, Major N. S. H. (R.A.)	Paris.
Skinner, Lt.-Col. J. M. (I.M.S.)	Bombay.
Skrine, Capt. P. R. H.	London.
Sladen, J. M. (I.C.S.)	Karachi.
Sladen, Dr. R. J. L. (F.R.C.S.)	Bombay.
Slater, A. F. (A.M.I.M.E., M.B.E.)	London.
Slingsby, Major T.	Wellington.
Smith, A. Kirke (*Life Member*)	Bombay.
Smith, A. St. Alban	Singapore.
Smith, Capt. C. C. H.	Hangu.
Smith, Capt. D. R.	Mount Abu.
Smith, H. C. (*Life Member*)	London.
Smith, Major G. de Heriez (*Life Member*)	Ootacamund.
Smith, Dr. Malcolm	London.
Smith, W. J. L.	Palaw.
Smyth, C. P.	Alipore.
Smyth, J. L.	Madapur.
SOCIETIES—	
Royal Society of	Edinburgh.
New York Zoological Society	New York, U.S.A.
Sokhey, Major S. S. (I.M.S.)	Bombay.
Souter, C. A. (I.C.S., C.S.I.)	Madras.
Sparrow, Col. R.	England.
Spence, Dr. Arthur D., M.B., Ch.B. (EDIN.) (*Life Member*)	,,
Spence, Sir Reginald, *Kt.* (*Life Member*)	Bombay.
Spong, Major William A. (R.A.M.C.)	Cawnpore.
Spooner, T. J. (C.E.) (*Life Member*)	Europe.
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Stable, Capt. R. H. (D.S.O.)	Secunderabad.
Stables, Major Alex. (R.A.M.C.)	Scotland.
Standen, Sir B. (K.C.I.E., I.C.S.) (*Life Member*)	Europe.
Stanford, J. K. (M.C., M.A., M.B.O.U., I.C.S.)	Rangoon.
Stanton, W. C. (*Life Member*)	London.
Stapylton, J. M. (I.C.S.)	Mandla.
Steele-Perkins, Lt.-Col. C. S.	Calcutta.
Stent, P. J. H. (I.C.S.)	Nagpur.
Stevens, Herbert (F.Z.S., M.B.O.U.)	England.
Stevenson, Capt. H. A. (I.A.)	Shillong.
Stewart, C. G. (I.P.S., M.A.) (*Life Member*)	Insein.
Stewart, Prof. R. R. (Ph.D.)	Rawalpindi.
Stileman, D. F. (I.F.S.)	England.
Stilemans, Mrs. F. F.	Bombay.
Stirling, J. H.	Jodhpur.
Stirling, Col. Wm. (C.M.G., D.S.O., R.A.)	London.
Stockley, Lt.-Col. C. H. (D.S.O., O.B.E., M.C.)	Srinagar.

Stokes, Hon'ble Mr. H. G. (C.I.E., I.C.S.)	Madras.
Stokes, I. W.	England.
Stoney, R. F.	Kilpauk.
Storey, J. O.	Alleppey.
Strauss, M.	,,
Studd, B. C.	Calcutta.
Studd, E. (*Life Member*)	,,
Sturm, Lt. M. G. deL'Isle (R.A.M.C.)	Belgaum.
Sudan Government Museum, The Curator	Khartoum.
Suket, H. H. Raja Lakshman Sen (*Life Member*)	Suket.
Sultanbhoy Hajeebhoy	Bombay.
Sundari Bai, Shrimati	Calicut.
Surguja, Maharaja Ramanuj Saran Singh Deo (C.B.E.) (*Life Member*)	Surguja.
Suter, Dr. M. F. (D.SC.)	Bombay.
Swaine, J. K. (*Life Member*)	Matang.
Swan, E. J. A.	Papun.
Swithinbank, Mrs. B. W. (*Life Member*)	Rangoon.
Sykes, H. E. The Right Hon'ble Sir Frederick (P.C., G.C.I.E., etc.)	London.
Sylvester, E. C.	Vandiperiyar.
Symes, A. W. J.	Abu Road.
Symons, C. T.	Colombo.
Symons, Major-General Sir T. H. (I.M.S., O.B.E., C.S.I., K.B.E.)	London.
Tait, Major H. C. (I.M.S.)	Bombay.
Taleyarkhan, K. M. (Bar.-at-Law)	,,
Tasker, T. J. (O.B.E., I.C.S.)	Hyderabad, Dn.
Tata, Sir Dorabji J., *Kt.* (*Life Member*)	Bombay.
Tate, Major J. C. (I.A.)	Rajkot.
Taylor, Lt.-Col. J. (D.S.O., I.M.S.)	Rangoon.
Taylor, Dr. W. R. (M.R.C.S., L.R.C.S., D.P.H.)	Insein.
Tehri, Garhwal State, H. H. Raja Narendra Shah Saheb Bahadur (C.S.I.) (*Life Member*)	Tehri.
Tejpal, Laxmidas G. G.	Bombay.
Thatcher, E. C.	Sahuspur.
Theobald, Lt. J. A.	London.
Thom, W. S.	Kalaw.
Thomas, B. S.	Muscat.
Thomas, P. J. P.	Calcutta.
Thompson, C. H. (I.F.S.)	Thayetmyo.
Thomson, Major D. B.	England.
Thomson-Glover, Capt. J. W. (C.B.E.) (*Life Member*)	Peshawar.
Thorne, J. A. (C.I.E., I.C.S.)	Vallam, Tanjore.
Thornton, H. A. (C.I.E., I.C.S.)	London.
Thursfield, R. M. C.	Shwebo.
Tibbs, Rev. Canon P. G.	Chelsea.
Ticehurst, Dr. C. B. (M.A., M.B.O.U., R.A.M.C.)	England.
Tiddy, D. R.	,,
Tilden, H. B. (F.C.S.)	London.
Todd, A.	Calcutta.
Tombazi, N. A. (F.R.G.S., A.C.)	Karachi.

Transvaal Museum, The Director	Pretoria.
Travers, Sir Walter, *Kt.* (C.B.E., C.I.E.)	Jalpaiguri.
Traylen, G. D.	Bombay.
Treasuryvala, N. J.	,,
Treuthardt, M.	Calcutta.
Treshan, C. H.	Solon.
Trevenen, Major W. B.	Jubbulpore.
Triggs, Bernard	Europe.
Trivandrum, The Govt. Mus. and Public Garden, The Superintendent	Trivandrum.
Trotter, Genl. E. W.	Bangkok.
Turkhud, Dr. D. A. (M.B., C.M., etc.)	Kodaikanal.
Turner, G. M.	Bhamo.
Turner, Mrs. M. Carrington	Dehra-Dun.
Turner, Sir Montague	London.
Tutein-Nolthenins, A. C.	Ohiya.
Twinberrow, J. D. (M.C., I.P.)	Lahore.
Tyrrell, Lt.-Col. J. R. (C.I.E., I.M.S.)	Bombay.
Tyson, John D. (I.C.S.)	Calcutta.
Tytler, Major-Genl. Sir Harry (K.C.B., C.I.E., C.M.G., D.S.O.)	England.
Ubsdell, A. R.	Calcutta.
Udaipur, H. H. The Maharana Saheb Bahadur of	Udaipur.
University of Amoy, The Head of the Department of Zoology	Amoy, China.
University of Calcutta, The Librarian	Calcutta.
University of Dacca, The Librarian	Dacca.
University of Madras, The Registrar	Madras.
University of Rangoon, The Registrar	Rangoon.
U. P. Chief Conservator of Forests	Naini Tal.
Upton, Sir Thomas (*Kt.*)	New Delhi.
U. S. Department of Agriculture, The Librarian	Washington, D. C.
Van Ingen, DeWet	Mysore.
Venning, Brigadier F. E. W. (C.B.E., D.S.O.) (*Life Member*)	Multan.
Vernay, A. S. (*Life Member and Vice-Patron*)	London.
Vernon, H. A. B. (C.S.I., I.C.S.)	,,
Vesugar, Jamshed (*Life Member*)	Europe.
Victoria Memorial Park, The Honorary Secretary	Rangoon.
Vijayarajji, Maharaj Kumar, Shri	Bhuj-Cutch.
Villar, A. R. (I.F.S.)	London.
Volkart, L.	Zürich 7.
Wadia, D. R. D. (Bar.-at-Law)	Bombay.
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CONTENTS OF VOLUME XXXIV, No. 3

PAGE

The Game Birds of the Indian Empire. By E. C. Stuart Baker, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U., Part XII. (*With a coloured plate*). 613

Revision of the Flora of the Bombay Presidency. By Rev. E. Blatter, S.J., Ph.D., F.L.S. Part XIII. 623

The Lions of Asia. By R. I. Pocock, F.R.S. (*With five plates*). ... 638

The Birds of the Prome District of Lower Burma. By J. K. Stanford, M.C., I.C.S. and Dr. Claud B. Ticehurst, M.D., M.A., M.B.O.U., F.R.G.S. (*With a Map*). 666

The Panther as I have known him. By Lt.-Col. A. H. E. Mosse, I.A., F.Z.S. Part III. (*With a plate*). 673

Abnormal Tusks of Elephants. By Sir Frank Colyer, K.B.E., F.R.C.S. (*With six plates*). 694

Fishing in the Rivers of C. P. By Major W. B. Trevenen. (*With three text figures*). 700

Some Beautiful Indian Trees. By Rev. E. Blatter, S.J., Ph.D., F.L.S. and W. S. Millard, F.Z.S. Part V. (*With two coloured plates, and two black and white plates*). 716

The Study of Indian Birds. By H. Whistler, F.Z.S., M.B.O.U. Part VI. (*With a plate and two text figures*). 720

The Malaria Problem in Bombay. By Major G. Covell, M.D., D.P.H., D.T.M. and H., I.M.S. (*With a Map*). 736

The Ornithological Station at Heligoland. By Salim A. Ali, M.B.O.U. (*With four plates and a Diagram*). 743

A New Indian Dragonfly. By Lt.-Col. F. C. Fraser, I.M.S., F.E.S. (*With two text figures*). 752

The Origin of Continents and Oceans. (*With one plate and five Diagrams*). By W. E. Wait, M.A., F.Z.S. 754

On the Nesting of the Crested Swifts. By H. Whistler, M.B.O.U., F.Z.S. (*With two plates*). 772

The Stinging Caterpillar. By C. Major R. W. G. Hingston, I.M.S. (*With five text figures*). 778

The Toxicity of the Venom of Indian Scorpions. By Rev. J. F. Caius, S.J., F.L.S. 788

Reviews.—

1. Systema Avium Æthiopicarum. Part II. 790
2. Handbook of the Birds of West Africa. 791
3. The Motor Mechanism of Plants. 791
4. Lehrbuch der Allgemeinen Pflanzengeographie. 793
5. Plant Studies. 794
6. Zoology. 794
7. General Botany. 795

PAGE

MISCELLANEOUS NOTES—

I.—Three tigers at a kill. By Major C. Swire. (With a photo). 796

II.—Panther climbing up to a machan. By R. C. Morris. 797

III.—A Panther incident. By G. de L'Isle Sturm. 798

IV.—Note on the Malay Bear (*Ursus malayanus*). By Major E. G. Phythian-Adams. (With a photo). 798

V.—Sounds made by Porcupines. By R. C. Morris. 799

VI.—Observations on the Indian Elephant. By R. C. Morris. ... 800

VII.—On distinguishing between males and females and other controversial matters pertaining to the Gaur. By R. C. Morris. 801

VIII.—Vigils at waterholes. By A. Bayley-de Castro, I. M. D. ... 802

IX.—The heart shot in game. By R. C. Morris. 804

X.—The Common Mynah (*A. tristis*) as a pest in Seychelles. By P. R. Dupont. 806

XI.—On the occurrence of the Grey-backed Shrike (*Lanius tephronotus* Vigors) in the suburbs of Calcutta. 807

XII.—Breeding of the Great Stone Plover (*Œdicnemus recurvirostris*). By C. G. Chevenix Trench, I.C.S. 809

XIII.—Occurrence of the Tufted Pochard (*Nyroca fuligula*) in Gilgit. By Capt. M. H. Berkeley. 809

XIV.—First Indian record of the Eastern Grey Duck (*Anas pœcilorhyncha zonorhyncha*, Swinhoe) and the occurrence of the Eastern White-eye (*Nyroca rufa baeri*, Radde) in Bihar. By C. M. Inglis, F.Z.S., M.B.O.U. 810

XV.—Migration notes from Kohat, N. W. F. P. By Lt.-Col. G. de la P. Beresford. 810

XVI.—Birds of a Himalayan torrent. A study in behaviour. By Major R. W. G. Hingston, I. M. S. 811

XVII.—Birds seen on a trip from Pottuvil to Kumna (Ceylon). By G. Brown. 815

XVIII.—A list of some birds of the seven hills of Naini Tal, U. P. By Major General Corrie Hudson. 821

XIX.—Notes on the Star Tortoise (*Testudo elegans*). By R. Shunker Narayan Pillay. 828

XX.—Capturing Monitor Lizards and Pythons. By Frank C. Riches. 828

XXI.—Masheer fishing in Burma. By Capt. S. C. MacGregor. 829

XXII.—Ant-mimicking Spiders as victims of Wasps. By K. Kunhi Kannan. (With a photo). 831

XXIII.—A freak *Papilio polytes romulus* Cr. ♀. By O. C. Ollenbach. (With a plate). 832

XXIV.—Notes on *P. marshalli* and *P. sita*. By J. A. Yates. 833

XXV.—Notes on *Appias libythea libythea* ♀. By J. A. Yates. 834

PAGE

XXVI.—On the peculiar cross-vein-like structures in the hind-wings of *Croce filipennis* Westw., ♂ (*Nemopteridæ*). By S. Mukerji, M. Sc. (With a plate). 834

XXVII.—Butterfly collecting grounds at Mussoorie, U. P. By O. C. Ollenbach. 836

XXVIII.—On the true nature of the nuclear divisions in old internodes of local *Tradesiantia* stems. By S. R. Bose. (With a plate). 840

XXIX.—On the occurrence of the vegetative buds on the root of gram. By T. C. N. Singh. (With a text figure). 841

XXX.—An instance of anomalous branching of the conjugation-tubes of an Indian form of *Spirogyra neglecta* (Hass) Kuetz. By Kanti Gopal Banerjee. (With a plate) 842

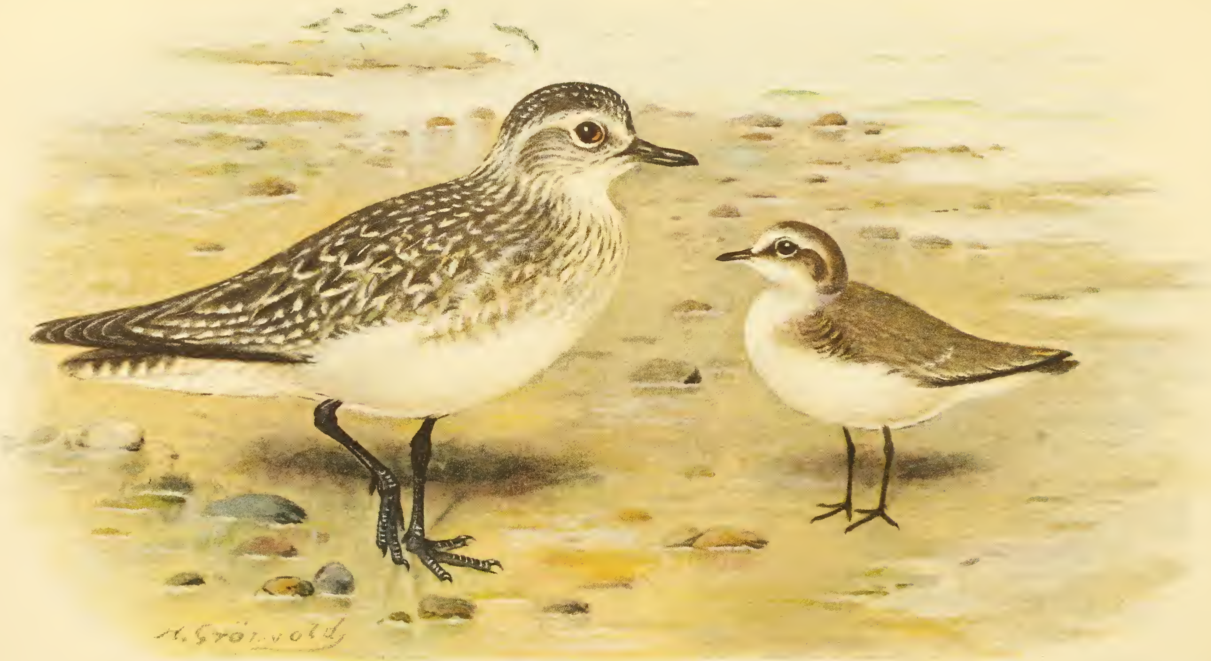
XXXI.—Some Liverworts of the Order *Marchantiales* from Burma. By L. P. Khanna. 844

XXXII.—Notes on Broomcorn with 5 brushes. By Mr. S. S. Nehru, I. C. S. 847

XXXIII.—Cultivation of Broomcorn in India. By Mr. S. S. Nehru, I. C. S. 847

PROCEEDINGS. 850

CONTRIBUTIONS TO THE MUSEUM FROM 1ST JANUARY 1930 TO THE 30TH SEPTEMBER 1930. 855



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THE EASTERN GREY PLOVER. 2/5.
Squatarola squatarola hypomela.

THE INDIAN KENTISH PLOVER. 2/5.
Leucopolius alexandrinus seebohmi.

JOURNAL
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NOVEMBER, 1930 VOL. XXXIV No. 3

THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XII

(*With a coloured plate*)

(*Continued from page 11 of this volume.*)

Genus : SQUATAROLA.

Squatarola Cuvier, Regne Anim., i, p. 497 (1816).

Type by tautonomy, *Tringa squatarola* Linn.

In the genus *Squatarola* there is present a small hind toe and claw ; the bill is straight, stout and about as long as the head ; the nostrils are linear and placed fairly close to the base of the bill in a rather deep, broad groove; the wing is long and pointed and the first primary longest ; the tail is short and rounded; the tarsus is covered with hexagonal scales ; outer and middle toes connected by a small web at the base. The genus is almost cosmopolitan.

SQUATAROLA SQUATAROLA.

Key to SUB-SPECIES.

A. Rather more brown, less grey.
  Slightly larger ... ... *S. s. squatarola.*
B. Rather more grey, less brown.
  Slightly smaller ... ... *S. s. hypomela.*

The difference between the Eastern and Western birds is very slight and perhaps hardly worth recognising subspecifically. In Winter plumage, however, the colour of the upper parts in the Eastern birds certainly seems more grey.

SQUATAROLA SQUATAROLA SQUATAROLA.

The Western Grey Plover.

Tringa squatarola Linn., Syst. Nat., 10th ed., vol. i, p. 149 (1758) (Sweden),

Squatarola helvetica.—Blanf. & Oates, vol. iv, p. 236 (part).

Vernacular Names.—Barra batan (Hind.)

Description.—Breeding plumage. Upper plumage a pearly-grey, banded everywhere with black, the long scapulars being paler brown with blackish bars and white indentations; primaries blackish-brown with long wedge-shaped white marks on the inner webs; outer secondaries with white bases; extreme forehead, round the eyes, sides of the head and lower plumage to vent black; under wing-coverts, thighs, vent and under tail-coverts white; axillaries black and white.

Colours of soft parts.—Iris dark brown; bill black; legs and feet dusky grey.

Measurements.—Wing 189 to 201 mm.; tail 73 to 83 mm.; tarsus 45 to 51 mm.; culmen 28·0 to 30·5 mm. (Hartert.)

In non-breeding plumage the forehead and lores are white, speckled with black; rump and upper tail-coverts white with narrow bars of brown; remaining upper plumage dark brown, each feather edged paler; scapulars and wing-coverts with broader white tips and semi-bars: sides of head and neck white streaked with brown; breast and flanks white, lightly barred with pale brown; remainder of lower parts white.

Chick in down.—The head is regularly marked yellowish-white, the ground more golden, mottled with black. Hind neck black, down with yellowish-white tips. Remaining upper sides of the body and thighs mottled yellow and black, under parts greyish-white, the breast appearing rather darker, the down of this part having black bases. The chick is in fact very much like that of the Golden Plover but paler and duller.

Distribution.—Greenland, Eastern North America, Arctic Europe to West Siberia, migrating South in Winter to the coasts of Southern Europe, Africa to the extreme South, Madagascar, Seychelles, and to North-West India. Records from Eastern India, Burma and Ceylon all appear to refer to the next race.

Nidification.—The Grey Plover breeds in the Siberian tundras from Petchora eastwards to the Yenesei Province, where it meets the Eastern race. So far as is known at present, the bird does not commence to breed until late in June, whilst Seebohm, Harvie-Brown, Pearson and others found eggs until late in July. The nest is merely a depression in the moss, sometimes with practically no lining at all, at other times fairly well lined with moss and bracken and slender twigs. The bird seems to be very shy about approaching its nest so long as the observer moves about; but once the latter lies down and keeps perfectly still, then within a very few minutes the hen bird usually returns to her nest. Sometimes, however, according to Seebohm, the bird will not return for half an hour or even longer, until the watcher in the cold and wet begins to give up all hope. Seebohm thus describes the behaviour of a pair of Grey Plovers, whose nest, the third that morning, had been found by one of his Samoyedes.

'This time I lay down behind a ridge some thirty yards from the nest, and after waiting a quarter of an hour caught sight of the bird on the top of a distant tussock. Presently she ran nearer to another ridge, looked round, and then ran on to the next, until she finally came within fifty yards of where I was lying. I had just made up my mind to risk a shot when she must have caught sight of me, and flew right away. In a quarter of an hour I caught sight of her again, approaching by short stages as before, but from an opposite direction. I must have been in full sight of her. When she had approached within fifty yards of me, as near as I could guess, I fired at her with No. 4 shot, and missed. I remained reclining where I was, with little hope that she would try a third time to approach the nest, and whiled away the time with watching a Buffon's skua through my glass as it cautiously approached in my direction. Turning my head round suddenly I caught sight of the Grey Plover running towards the nest within fifty yards of me. I lifted my gun and fired again, but was so nervous that I missed her a second time. I was so vexed that I got up and walked towards the skua, which still remained *in statu quo.* I missed a shot at it too, spent some time in a vain search for its nest, and returned to my old quarters. In ten minutes I saw the Grey Plover flying up. It took a wheel in my direction, coming almost within shot, and evidently took stock of me, and satisfied itself that I was a harmless animal practising with blank cartridge, and having no evil design upon its eggs. It alighted about fifty yards beyond the nest, and approached less timidly than before. When it came within fifty yards of me, I fired, this time with No. 6 shot, and laid the poor bird upon its back. As we returned to our boat Harvie-Brown found a fourth nest, and, after watching as before secured the bird.'

Like most other birds of the family, whilst the hen bird is sitting, the male Grey Plover usually sits on some slight elevation from whence he can watch for any danger approaching the nest, upon sighting which he at once gives his wife due notice by a rather shrill plaintive whistle rapidly repeated.

Pearson found that occasionally the Grey Plover made its nest amongst the very coarse grass on low ground close to rivers. Normally the number of eggs laid is, of course, 4, but on several occasions the author above referred to found hard set clutches of 3, or three young birds in a nest, so it would appear that the Grey Plover does not so invariably lay 4 eggs in a clutch as does the Golden Plover. The eggs are very similar to those of the latter bird, but average rather larger and perhaps a trifle longer in proportion. In colour they are less rich than those of the Golden Plover but otherwise very similar. The ground colour varies from a very pale grey or yellowish stone colour, sometimes almost white, at other times tinged with olive or buff. The primary markings consist of reddish-black and black blotches or spots, often running into one another. At the larger end of the egg the markings are numerous and often form a cap or, less often, a zone, but on the rest of the egg are less numerous. The secondary markings are of light grey and pale neutral tint, fewer in number than the primary markings and sometimes practically absent. Jourdain gives the average of 40 eggs as 51·6 × 35·9 mm.; maxima *55·2* × 35·6 mm. and 50·7 × *38·0* mm.; minima *45·7* × 39·7 and 51·9 × *34·0* mm. Incubation apparently takes 16 to 18 days.

Habits.—Here in India we only know the Grey Plover as a bird which haunts wide open spaces in flocks, often of considerable size, which tantalize the sportsman by constantly wheeling about within sight, but well out of shot. When feeding, the individuals of the flock as a rule keep fairly close together, though at times they will scatter over a considerable area. They prefer ploughed lands, open grass-lands and cultivated fields in which the crops are only a few inches high, but I have seen both this and the next race feeding on the almost entirely open sandy banks and islands of our great rivers, where they seem to be feeding on what appears to me to be a microscopic shrimp or sandhopper, their stomachs being full of these when killed. I found it absolutely impossible ever to approach these birds within shot when they were thus engaged, but I often obtained a couple, or rarely, four shots, by lying flat on the bank and then sending a boat to approach them from the opposite side of the river. In this way when they first rose they would often give me an easy right and left and sometimes on catching sight of the boat again as they wheeled, would again give me a second chance. In the fields we often got quite good shooting when the birds first came and were very numerous, by simply crouching behind a hedge and having the birds driven up to us, but even then five or six couple to a gun was quite a good morning's sport.

The Grey Plover cetainly deserves a place in the list of true sporting birds, for he is as difficult to hit as he is pleasant to eat, once he has been brought to bag. Few birds are really more difficult to circumvent, once suspicion is aroused, and they are so fast on the wing, turning and twisting so quickly even when flying in large flocks, that the shots they give are generally fairly difficult ones.

In Western India they are said to collect in very large flocks, sometimes of many hundreds, but in Eastern India, where as a matter of fact the next race is the common form, flocks of 20 to 30 are the rule and anything over a hundred exceptional.

Their food is almost entirely insectivorous, but they will eat anything almost in the way of small worms, crustaceans, molluscs, etc., and are particularly fond of the larvæ of grasshoppers. It is said also that they occasionally eat seeds but I do not remember ever having found such among the contents of their stomachs.

Their call is a shrill musical pipe, constantly repeated when the birds are on the wing, but only occasionally uttered on the ground when feeding. The alarm note is a rather sad double whistle repeated two or three times at intervals of a couple of seconds.

SQUATAROLA SQUATAROLA HYPOMELA.

The Eastern Grey Plover.

Charadrius hypomelus Pallas, Reise Russ. Reichs., vol. iii, p. 699 (1776) (East Siberia).

Squatarola helvetica.—Blanf. & Oates, vol. iv, p. 236 (part).

VernacularNames.—Barra Batan (Hind).

Description.—A slightly smaller bird and distinctly more grey, less brown in the non-breeding plumage.

Colours of soft parts as in the typical form.

Measurements.—Wing 175 to 193 mm.

Distribution.—Eastern Siberia to Japan. In Winter, South to Australia, Tasmania, South China and Burma. The Assamese birds are nearly all of this race and they occur in Eastern Bengal and down the East coast to Ceylon, where they are by no means very rare.

Nidification.—This bird undoubtedly breeds on the East Siberian tundras, and eggs, taken by Smirnoff in Manchuria and also in the south-west of the Province of Yakutsk on the tundras west of the Lena, are assuredly of this sub-species for they seem to be too big to be those of the Western Grey Plover which breeds in the same areas. The only eggs I have seen of his, measured about 51·3 × 34·8 mm. and are indistinguishable from those of the Western race. They were taken in early July.

Habits.—The habits of the Eastern form of Grey Plover differ in no way from those of the Western. It is a common bird in Assam, Eastern Bengal, and Burma, occurring frequently as far south as Ceylon. A male in full breeding plumage which I shot from a flock of many hundreds, had been feeding entirely on a small black beetle which infested the mustard crops in myriads, extending into the ploughed fields all round the latter.

Genus : LEUCOPOLIUS.

Leucopolius Bonap. Comp. Rend., vol. xliii, p. 417 (1850).

Type by taut., *Ægialitis marginata* Vieillot.

This genus has hitherto been generally united with *Charadrius* (*Ægialitis* auct.), of which *hiaticola* is the type. It differs, however, from the birds of that group, according to Lowe, in having the lacrymals free and presenting outward projecting processes like the Gulls; there is no foramen for the nasal duct, its place being taken by a groove.

In *Leucopolius* most of the characters, except the important ones mentioned above, are also those of *Charadrius*. The bill is small and practically straight; the tarsus fairly long and reticulated throughout; there is no hind toe.

Key to SPECIES.

A. White band on hind-neck not divided from back by black band ... ... *L. alexandrinus.*

B. White band on hind-neck separated from back by a black band ... ... *L. peronii.*

Leucopolius alexandrinus.

Key to Sub-species.

A. Upper parts with no trace of rufous in breeding plumage; culmen 13 to 15 mm.
  (*a*) Wing 106 to 114 ... ... *L. a. alexandrinus.*
  (*b*) Wing 93 to 107 ... ... *L. a. seebohmi.*
B. Upper plumage suffused with rufous; culmen 17 to 19 mm. ... ... *L. a. dealbatus.*

Leucopolius alexandrinus alexandrinus.

The Kentish Plover.

Charadrius alexandrinus Linn., Syst. Nat., 10th ed., vol. i, p. 150 (1758) (Egypt).

Ægialitis alexandrina. Blanf. & Oates, vol. iv, p. 240 (part).

Vernacular Names.—Punchi-olēyiyā (Cing.); *Sinna-kōtān* (Tam.).

Description.—Forehead white, followed by a broad black patch; above and behind the eye white; lores black, running back under the eye and in a streak behind; anterior crown, nape and hind neck rufous, more grey on the nape; whole remaining upper plumage sandy grey-brown, the four middle tail-feathers blackish, the outermost white throughout and the intermediate white on the outer webs and tips, blackish elsewhere; primaries blackish, the first white-shafted throughout, the others increasingly brown at their bases; innermost secondaries like the back, outer blackish-brown with white tips and edges; median, greater and primary coverts blackish with white tips forming wing-bars; a broad black patch on each side of the breast, remainder of lower plumage white.

Colours of soft parts.—Iris brown; bill black; legs and feet plumbeous–grey.

Measurements.—Wing 106 to 114 mm. (one 118); tail 48 to 50 mm.; tarsus 27 to 29 mm.; culmen 13 to 15 mm. (one 16 mm.)

In Winter the rufous and black crown is lost, these parts assuming the colour of the back: the white forehead is restricted in extent and the black eye-streak is replaced by grey-brown.

Female similar to the male in Winter but with less white on the forehead; the lores, ear-coverts and eye-streak are sandy-brown and the breast-patches brown. In Summer, when freshly moulted, the edges of the feathers of the crown, as well as those of the brown breast-patches, have rufescent edges.

Young birds are like the female but have nearly all the feathers of the upper part fringed with sandy-buff.

Nestling in down.—Forehead, a ring round the back of the neck and the lower parts white; an ill-defined eye-streak dark brown and sometimes faint indications of a black edging to the crown; a dark brown horse-shoe mark on the wings; upper plumage and crown pale buffy-grey speckled with brownish.

Distribution.—Breeding in Europe and Western Asia to Mesopotamia and Sind. Several specimens in the British Museum collection from Khandesh in Bombay with wings 106 to 111 mm. and culmens over 15 mm. are in my opinion also of this race and not *seebohmi* as noted on their data labels.

Nidification.—The Kentish Plover breeds over practically the whole of Europe and a great part of Western Asia through Mesopotamia to Sind, while it is also probable that a few birds may even breed so far South as the Northern parts of the Bombay Presidency. The breeding season is apparently a very long one, but doubtless varies a great deal according to the rainfall. In Mesopotamia, Cumming found young ones hatched as early as March 9, which infers that the eggs were laid in the latter part of February. On the other hand, Bulkley took eggs in the Rann of Cutch as late as August. The majority of eggs will, however, be found in April and May. Birds which lay early probably have a second brood in June and July. The birds breed invariably either on large sandy wastes and sandhills or on the sea shore, the nest as a rule being nothing more than a shallow scrape lined with bits of broken shell, dead leaves or tiny pebbles. The birds cannot be said to breed in colonies, though where one nest is taken, other nests may be found in the near vicinity, yet nowhere do they collect in close nesting communities like the Terns and Pratincoles. In Sind, Ticehurst found a favourite site to be the top of one of the little wind-blown mounds which pile round the Sueda bushes. Ticehurst believes that the Kentish Plover breeds on the sand banks of rivers like the Indus in Upper Sind and is probably correct in this, although I have never received eggs thence. Like most of the small Plovers the hen bird leaves the nest at the slightest sign of danger and she is generally assisted by the male who spends much of his time seated on some prominent point not far from the nest and gives his warning note when he sees his enemies afar off. He is not, however, nearly as vigilant a guard as the Golden Plover, so that often his wife has to depend on her own cleverness in avoiding danger. The nests are not difficult to find, as, each time the little birds visit them they alight some distance away and then run up to the nest, so that in a short time there is a network of footprints all round and leading up to it. The number of eggs laid is either three or four, most often the former. In shape they are typical little Plover's eggs, that is to say a conical oval, and they are so deposited in the nest that they lie point to point with the larger ends raised above the smaller. The ground colour varies from pale yellowish—or greyish—stone to an olive or buff brown, sometimes quite rich in tint. The markings consist of small blotches, specks and scrawls of black or blackish brown, generally most numerous at the larger end. In most eggs also there are a few secondary markings of pale grey but these are very inconspicuous and often absent. 100 British eggs average 32·5 by 23·5 mm.; maxima *35·2* by 23·7 mm. and 32·0 by *25·0* mm.; minima *30·2* by 23·2 mm. and 32·6 by *22·5* mm. Indian eggs average almost exactly the same, but the minima are 31·2 by 23·1 mm. and 32·0 by 21·5 mm.

When the nest is discovered or when there are young hatched, both cock and hen bird often try to lure an observer away from the eggs or young by feigning injury, and, it is said that they will repeat this trick time after time, showing that it is performed as an act of reason or instinct and not merely as an uncontrollable impulse.

Habits.—Within Indian limits, the Kentish Plover is confined to the North-West only, but, wherever found, is comparatively common, in the winter sometimes associating in small flocks ; it is, however, a sedentary bird and its numbers do not appear to be augmented in winter by others on migration. In that season it is found more inland and more often on the banks and islands of the larger rivers than in the breeding season. Wherever found, however, it keeps always to open land such as sandy banks and shores, open dry country or the dry mud banks surrounding the lakes and swamps. Its flight is typically that of a Plover, of considerable speed and varied with many turns and twists. It also runs swiftly, generally proceeding in little spurts, head and tail depressed, each spurt finishing with a little halt when the bird stands for a moment or two with head erect. It is noticeable in life that the Kentish Plover and indeed most other small Plovers seem to keep their heads tucked in close to their shoulders and one very seldom sees the neck raised in the manner so often depicted in illustrations. They feed on tiny crustacea, mollusca and insects. Ticehurst found those he examined had fed entirely on tiny crabs, whilst others have been found to contain nothing but sandhoppers. Its breeding note is a rather sweet trill, uttered whilst it flies about in the air more like a butterfly than a bird. Its alarm note is a shrill double whistle, syllabified by Witherby as ' too-it, too-it, ittup, ittup.'

LEUCOPOLIUS ALEXANDRINUS SEEBOHMI.

The Indian Kentish Plover.

Charadrius alexandrinus seebohmi, Hartert & Jackson, Ibis, 1915 p. 529 (Ceylon).

Ægialitis alexandrina.—Blanf. & Oates, vol. i, p. 240 (part).

Vernacular Names.—*Puchi-oleviva* (Cing.) ; *Sinna-kotan* (Tam.).

Description.—Slightly smaller than the preceding bird and with a rather smaller bill ; it is also rather browner and darker.

Colours of soft parts as in the typical form.

Measurements.—Wing 93 to 107 mm. ; culmen 13 to 15 mm.

Distribution.—Coasts of the Red Sea, Somaliland and Ceylon.

Nidification.—The Indian Kentish Plover breeds in some numbers on the shores of Ceylon and on the thin sandy pastures around them, whilst it also occasionally breeds on the shores of the huge inland tanks. The nest is a shallow scrape made in sand or mud but, unlike the preceding bird, it is very seldom lined with shells, etc. On the other hand, whilst the Northern race seldom seems to bury its eggs except by accident, the Ceylon bird appears very often to lay them in loose sand which it piles round them until they are buried, or almost buried in it. The eggs of course are merely small fac-similes of those of the larger race and the only difference in colouration is that on the whole this little bird's egg is the more richly coloured and occasionally almost of a reddish buff ground. 40 eggs average 29·9 by 22·0 mm. ; maxima *33·2* by 22·0 and 29·9 by *23·4* mm.; minima *29·1* by 22·3 and 29·3 by *21·3* mm.

The majority of birds breed during June or July, but Wait has taken eggs from the end of April to early September. The number of eggs laid is usually three, never four, though two only are sometimes incubated.

Habits.—This little Plover is a permanent resident wherever found, though it may range over a larger area of country in winter than in summer. In voice, flight and diet it does not differ in any way from its European relatives but, in the non-breeding season, it may be more often found in small flocks of from half a dozen to a dozen. It is said to be comparatively common on the great inland lakes or tanks in Ceylon at some distances from the sea and also to frequent grass fields when these are dried up from the sun and very bare. Legge describes them as far from shy, though much wilder in some localities than in others.

LEUCOPOLIUS ALEXANDRINUS DEALBATUS.

The Chinese Kentish Plover.

Ægialitis dealbatus Swinhoe, P.Z.S., 1870, p. 138 (S. coast of China).

Ægialitis alexandrina. Blanf. & Oates, iv, p. 240 (part).

Vernacular Names.—None recorded.

Description.—Differs from the two preceding birds in being slightly larger on an average and in having a longer bill; in breeding plumage the upper parts are often suffused with rufous.

Colour of soft parts as in the other races.

Measurements.—Wing 106 to 113 mm., tail 45 to 50 mm.; tarsus 28 to 30 mm.; culmen 17 to 18 mm. (one 19 mm.). The bill is also slightly stouter than in the other races. In a large series of Chinese specimens, it measures 16 to 19 mm.

Distribution.—The coasts and large tidal rivers of South China and the Indo-Chinese countries. Four specimens have been obtained in Tenasserim and one as far west as Calcutta.

Nidification.—K. H. Jones found this bird breeding in some numbers on the sandy flats so common in the East Coast of China round about Chefoo. The nests were often found in close proximity to one another and, at other times, close to the nests of *Sterna sinensis.* At the same time they have never been known to breed in actual colonies. The nests are described as mere hollows in the sand in which the eggs, generally three in number, were deposited without any decorative shells or pebbles. In one nest taken by Messrs. Vaughan and Jones there were five eggs which appeared to be the production of one bird. In appearance the eggs are like those of the European Kentish Plover. 50 of them average in size 32·4 by 22·8 mm.; maxima *34·9* by 24·3 and 33·3 by *24·4* mm. minima *29·8* by 22·0. The breeding season, so far as is known at present is restricted to May and June. It apparently breeds all round the East and South east coasts of China, for Jones records it as one of the most common breeding birds on the Yellow Sea and Gulf of Pechili, whilst Latouche records taking eggs as far south as Swatow and also observed the bird near Hong-Kong at the end of May.

Habits.—The Chinese Kentish Plover seems to differ from the preceding race in that it is to some extent a migratory bird. Jones remarks that these birds breed in thousands on the flat tracks of sand between Wei-hai-wei and Chefoo but that during September they leave for the South, at which season they may be found practically anywhere in South China, the Islands, and as far west as South Burma. In all other respects the habits of these birds differ in no way from those of their relations, though in their favourite haunts they would appear to be found in far greater numbers.

LEUCOPOLIUS PERONII.

The Malayan Kentish Plover.

Charadrius peronii Schlegel, Mus. Pays-Bas, p. 33 (1865) Borneo.

Vernacular Names.—None recorded.

Description.—Similar to *L. a. alexandrinus* but in breeding plumage the white band at the back of the neck is succeeded by a broad black band linking with the black breast-patches, whilst in Winter these patches are rufous and not black.

Colours of soft parts.—'Iris dark chocolate-brown; bill black, orange at the base; orbital skin orange; feet grey, claws black, (Everett).

Measurements.—Wing 92 to 101 mm.; tail 39 to 41 mm.; tarsus 28 to 30 mm.; culmen 14 to 15 mm.

Female has no black band across the forehead, whilst the black band above the scapulars and the breast-patches are replaced by brown mixed with rufous.

Distribution.—The islands of the Malay Archipelago, Java to the Philippines, Borneo and the Celebes.

Nidification.—At present there is very little known about the breeding of this little Plover, but Whitehead obtained young birds almost fully fledged as well as three eggs in Luzon on May 26. The eggs are described as 'pale cream, the whole shell covered with small blotches, streaks and zigzag pencilling of rich sepia and pale lavender.' The measurements of the eggs are 30 by 42 mm. The breeding range of this bird is probably a great deal more extensive than is at present known, for observers in China, Latouche, Jones, Vaughan and others have recorded its presence on the coasts of China as well as on some of the islands during May and June, when it assuredly must have been breeding.

Habits.—At present it is not known for certain whether this bird is entirely sedentary or more or less migratory. It has certainly been observed over a far greater range in winter than in summer. At the same time in the Philippines, where it is known to breed and at other points where it is supposed to breed, it is undoubtedly resident throughout the year. It appears to be almost exclusively a bird of the seashore or of waste land and mud flats in their immediate vicinity, and has hitherto never been found any distance inland. In flight, food and voice, etc., it differs in no way from the various races of *Leucopolius alexandrinus*.

(*To be continued.*)

REVISION OF

THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART XIII

ELATINACEAE (Cke. i, 72).

BERGIA, Linn. (Cke. i, 73).

Cooke's 3 species are here retained.

1. **Bergia odorata**, Edgew. in *Journ. As. Soc.* Beng. vii (1838), 765.

The plant, though generally decumbent or spreading, is sometimes pendulous. Leaves rather thick, varying from broadly elliptical in the more rigid small-leaved forms to oval, obtuse or subacute, crenate-serrulate, margin often revolute. Petals white. The filaments are opposed to the sepals. Styles purple. The plant has a smell like that of Chamomile.

Distribution : Rajputana Desert, Gujarat, Sind, Persia, Egypt, tropical Africa.

2. **Bergia ammannioides**, Roxb. Hort. Beng. (1814), 34.

Locality : Add : *W. Khandesh* (Blatter !).

Distribution : Throughout India (also Rajputana Desert) and Ceylon, Afghanistan, Persia, Egypt, tropical Africa, Australia.

3. **Bergia capensis**, Linn. Mantiss. (1771), 241.

Locality : Add : *Konkan :* Dadar (Blatter !).—*Deccan :* Igatpuri (Blatter !).

Distribution : A widely spread herb in the tropics of both hemispheres, not in S. Africa.

HYPERICACEAE (Cke. i, 74).

HYPERICUM, Linn. (Cke. i, 74).

Species about 200, 2 in the Bombay Presidency.

1. **Hypericum mysorense**, Heyne in Wall. Cat. (1828), 4808.

Distribution : W. Peninsula, W. Ghats in the Nilgiris, Anamalais, Pulneys, and Travancore hills above 5,000 ft., E. Ghats (Madgol hills), Ceylon.

2. **Hypericum japonicum**, Thunb. Fl. Jap. (1784), 295 *quoad descript.*, *tab. excl.*

Distribution : Temperate and subtropical Himalaya from Sikkim to Garhwal, Kasia Mts., Assam, Sylhet, Burma, N. Circars, hills of Ganjam, Deccan, W. Ghats from Nilgiris to Travancore above 5,000 ft., High Wavy Mt.—China, Java, Australia, N. Zealand, Japan to Philippines, Madagascar.

GUTTIFERAE (Cke. i, 75).

GARCINIA,' Linn. (Cke. i, 76).

Species about 180.—Tropical Africa, Asia, New Caledonia.

Cooke describes 5 species. *Garcinia spicata*, var. *macrantha*, T. Anders. is considered as a distinct species by Talbot : *G. malabarica*.

1. **Garcinia indica**, Chois. in DC. Prodr. i (1824), 561 ; Cke. i, 77.

Distribution : Bombay Pres. : Moist tropical rain forests of the W. Ghats evergreens of S. Konkan and N. Kanara ; Madras Pres. : W. Ghats of S. Kanara, Coorg and Wynaad.

2. **Garcinia Cambogia**, Desrous. in Lam. Encycl. iii (1789), 701 ; Cke. i, 77.—*G. papilla*, Wight Ic. t. 960, 961.—*G. conicarpa*, Wight Ic t. 121.

Distribution.—Bombay Pres. : Konkan, Southern Ghats of N. Kanara in evergreen rain-forests ; Madras Pres. : W. Ghats from Coorg to the Nilgiris and Travancore up to 6,000 ft. in evergreen and lower Shola forests (Gamble) ; Ceylon.

3. **Garcinia morella**, Desrous. in Lam. Encycl. iii (1789), 701 ; Cke. i, 78.

Distribution : E. Bengal, Khasia Hills, W. Peninsula : Kanara evergreen forests, W. Ghats from S. Kanara and Mysore to Travancore up to 3,000 ft.—Ceylon, Malacca, Singapore, Siam.

4. **Garcinia xanthochymus**, Hook. f. in Hook. f. F.B.I. i, 78 ; Cke. i, 78.—*Xanthochymus pictorius*, Roxb. Coromandel Pl. ii, 51. t. 196 (not *Garcinia pictoria*, Roxb.) —*X. tinctorius*, DC. Prodr. i (1824), 562.

In Gamble (Madras Fl. 74) this species appears under the name of *Garcinia tinctoria*, Dunn. Dunn remarks in Kew Bull. (1916), 64 that ' *Xanthochymus tinctorius*, DC. is the oldest available name for the species ; Roxburgh's *X. pictorius* is older but the trivial name is preoccupied by *G. pictoria*, Roxb. which is a different species.' (= *G. Morella*).

Dunn's new combination is founded on *X. tinctoria*, DC. Craib rightly thinks that this combination does not seem desirable since a reference to the Prodromus shows that *tinctorius* is clearly a misprint for *pictorius*.

Distribution : Eastern Bengal and E. Himalaya, Burma, Penang, Andamans, N. Circars, Ganjam, W. Peninsula on the Ghats from Bombay to N. Kanara, Mysore, Coorg, Nilgiris and N. Travancore up to 3,500 ft.

5. **Garcinia spicata**, Hook. f. in *Journ. Linn. Soc.* 14 (1875), 486 ; Cke. i, 78.—*Xanthochymus ovalifolius*, Roxb. Fl. Ind. ii (1832), 612.—*Garcinia ovalifolia*, Hook.f. in Hook.f. F.B.I., i, 269.—*Xanthochymus spicatus*, W. & A. Prodr. 102.

According to the above synonymy, the name *ovalifolia* has priority over *spicata*, but as Dunn points out in Kew Bull. (1916), 64, it was first used under *Garcinia* by Oliver in the Fl. Trop. Africa (i, 166) to designate a different species and is therefore not available for this one.

Locality : Add : Khandala (Blatter !) ; Bhimashunkar, Poona District (Talbot).

Distribution : W. Peninsula : From the Konkan southwards in evergreen monsoon and rain-forests, evergreen rain-forests from the Konkan and N. Kanara Ghats to Travancore at low elevations, Ceylon.

6. **Garcinia malabarica**, Talb. in *Journ. Bom. Nat. Hist. Soc.*, xi, pl. i, For. Fl. Bombay, i (1909), 96 ; Gamble Fl. Madras (1915), 74.—*G. ovalifolia*, Hook. f. var. *macrantha*, T. Anders. in Hook. f. F.B.I., i, 269.—*G. spicata*, Kurz. MS. in Herb. Calc. (ex Talbot).—*G. spicata*, Hook.f. var. *macrantha*, Cooke Fl. Bombay, i, 79.

Description : A small or medium-sized tree with sulcate, angular branchlets dilated at the insertion of the leaves and inflorescence. Leaves opposite, coriaceous, ovate or oblong, lanceolate, acute or obtuse, glabrous, shining above and beneath ; nerves numerous, anastomosing, distinct, midrib prominent beneath ; blade 15–8 by 6-2·5 cm. ; petioles 12–18 mm. long, rugose, dilated above the base, so that the two opposite ligular processes clasp the branchlets. Flowers dioecious. Male flowers white, 12–18 mm. across, numerous, sessile or shortly pedicelled, fascicled on short, axillary, thick peduncles ; pedicels bracteolate at the base. Sepals 4–5, orbicular, $\frac{1}{3}$ the orbicular, white, concave petals. Staminal phalanges 5, thick, equalling the petals, surrounded at the base by and springing from a lobed and plaited, thick fleshy disk ; anthers 12 on each phalange, didymous, free part of filament short, stout. Female flowers 1-6, axillary, fascicled. Sepals and petals of male. Staminodes in 5 thin, flattened phalanges surrounding the ovary and springing from the edge of a disk similar to that of the male flowers ; effete anthers 4-5 on each phalange, flat, didymous and on longer free filaments than those of the male flowers. Ovary 3-celled, crowned with the thick, 3-lobed spreading stigma (Talbot).

Locality : W. Ghats from N. Kanara southwards, common in evergreen rain-forests of the Gersoppa Ghat (Talbot).

Distribution : W. Ghats in N. and S. Kanara, Mysore and Coimbatore.

OCHROCARPOS, Thouars. (Cke. i, 79).

1. **Ochrocarpos longifolius**, Benth. & Hook.f. ex T. Anders. in Hook. f. F.B.I., i (1874), 270 (*Ochrocarpus*) ; Cke. i, 79.

Locality : Add : *Konkan :* Salsette (Blatter & McCann !).—*W. Ghats :* Khandala (Blatter !).—*N. Kanara :* Kumpta (Talbot).

Distribution : W. Ghats of the Konkan, N. Kanara, Malabar and Coimbatore ; cultivated in the N. Circars.

CALOPHYLLUM, Linn. (Cke. i, 80).

Species about 60.—Tropical Asia and America.

Cooke describes 3 species : *C. inophyllum*, Linn., *C. tomentosum*, Wight, *C. Wightianum*, Wall. For *C. tomentosum*, we have to substitute *C. elatum*, Bedd. and for *C. Wightianum C. apetalum*, Willd.

2. **Calophyllum elatum,** Bedd. Fl. Sylv. t. 2 ; Gamble Fl. Madras (1915), 76.—*C. tomentosum*, T. Anders. in Hook. f. F. B. I. i, 273 (*partim, non* Wight); Cke. i, 80.

Dunn (Kew Bull. (1916), 64) points out that the type of *C. tomentosum*, Wight Ill. I (1840), 128 is a Ceylon tree which has not been reported from the Madras Presidency, and he adds that the Travancore species is much less tomentose and should bear Beddome's name of *C. elatum*. Now the Bombay plant is identical with the Nilgiri and Travancore specimens and for this reason, the name *C. elatum* has been adopted.

Distribution : W. Peninsula : Evergreen forests from the Konkan southwards up to 5,000 ft. ; W. Ghats of N. Kanara, Nilkund and Gersoppa to the Nilgiris, Travancore and Tinnevelly, 1,000—5,000 ft. (not in Ceylon).

3. **Calophyllum apetalum,** Willd. in Ges. Naturf. Fr. Berl. Mag. (1811), 79 (*excl. stirp. zeylan.*) ; T. A. S. and C. E. C. F. in Kew Bull. (1926), 254.—*C. spurium*, Choisy in DC. Prodr. i (1824). 563 ; W. & A. Prodr. i (1834), 103.—*C. decipiens*, Wight Ill. (1840), 128 ; Ic. i. t. 106 ; Dunn in Gamble Fl. Madras I (1915), 76; Kew Bull. (1916), 64.—*C. Wightianum*, Wall. Cat. No. 4847 (1831), *nomen ;* Planch. *et* Triana in Ann, Sc. Nat. ser. 4, xv (1861), 256 ; T. Anders. in Hook. f. F.B.I. i, (1874), 274 ; Vesque in DC. Monogr. viii (1893) 569 ; Cke. i, 81.

Sprague and Fischer give the following explanation of the above synonymy (Kew Bull. 1926), 259 : 'Willdenow in 1811 gave the name *Calophyllum apetalum* to *Tajerou-ponna* Rheede, Hort. Mal. iv. 81, t. 39 (1683) and *Inophyllum flore quadrifido* Burm. Thes. Zeyl. 130, t. 60 (1737), which Linné (Sp. Pl. 514 : 1753) had erroneously included in *C. Calaba* L. In 1824, Choisy substituted the name *C. spurium* for *C. apetalum*, apparently on the ground that the latter was misleading. Wight and Arnott adopted *C. spurium* in 1834, but in 1840 Wight proposed the new name *C. decipiens*, because he had come to the conclusion that *spurium* was also misleading. He excluded Burmann's Ceylon plant from the species, calling it *C. Burmanni*.

'In 1861 Planchon and Triana took up the "nomen nudum" *C. Wightianum* Wall. Cat. n. 4847 for Rheede's species, because *apetalum* and *spurium* seemed to them unsuitable, and *C. decipiens* had been misapplied by Thwaites to a Ceylon plant, *C. Thwaitesii* Planch. et Triana. *C. Wightianum* has been accepted in the Flora of British India, in Vesque's monograph of the Guttiferæ, and by most recent authors. *C. decipiens*, however, was received by Dunn in 1915. Under the International Rules of Nomenclature, the fact that a name is considered to be misleading or inappropriate does not warrant its rejection, and the correct name for the species in question is *C. apetalum* Willd.'

MESUA, Linn. (Cke. i, 81).

1. **Mesua ferrea,** Linn. Sp. Pl. (1753), 515.

Locality : Add : *W. Ghats :* Panchgani (Blatter !)

Distribution : Mountains of E. Himalaya and E. Bengal, Assam, Tenasserim, Burma, Andamans, evergreen rain-forests of N. Kanara and S. Konkan, forests of the W. Ghats from S. Kanara to Travancore, up to 5,000 ft., Ceylon.

TERNSTROEMIACEAE (Cke. i, 82).

Cooke mentions 2 genera (*Eurya* and *Gordonia*), both of which should, in my opinion, be excluded from the Bombay Flora. There is no authentic specimen available to show that either *Eurya japonica*, Thunb. or *Gordonia obtusa*, Wall. has ever been gathered in the Presidency.

I include however :

Camellia Thea, Link Enum. Hort. Berol. ii, 73.—The Tea plant.

A shrub, 1–1·8 m. high. Branchlets glabrous, buds silky. Leaves 10–20 cm. by 3–6 cm., elliptic-oblong, acute, or cuspidate-acuminate, more or less serrate, membranous, puberulous on the nerves beneath ; petiole 4 mm. long. Flowers 3 cm. diam., white. Sepals orbicular, glabrous, with membranous ciliate edges. Petals broadly obovate, slightly coherent at the base. Stamens numerous, the outermost in many rows, slightly or almost wholly monadelphous, adherent to the base of the petals ; the innermost 5–12, free. Styles united for ⅔ their length. Capsule leathery, trigonous ; cells 1-, rarely 2-seeded. Seeds 18 mm. diam, nearly globose or obtusely angled, smooth, pale brown.

Locality : Cultivated at Bilar near Panchgani and about 6 miles from Panchgani towards Mahableshwar.

For discussion of distribution and nomenclature of Tea plant, see C.P.C. Stuart in Bull. Jard. Bot. Buitz. I (1919) fasc. 4.

DIPTEROCARPACEAE (Cke. i, 83).

Genera 16, species about 325.—Limited to the Indo-Malayan region from the Seychelles to New Guinea.—See E. D. Merrill Distribution of the Dipterocarpaceæ. Phil. Journ. Sc. 23 (1923), 1.

Dipterocarpus, Gærtn. f. (Cke. i, 84).

Species about 70.—

Cooke describes 1 species : *D. turbinatus*, Gærtn. f. This species as conceived by This.—Dyer in Hook. f. F.B.I. i, 295, Cooke Bombay Fl. i, 84 and Talbot For. Fl. Bomb. i, 108, fig. 65 combines 2 species : *D. turbinatus*, Gærtn. f. proper and *D. indicus*, Bedd. Brandis (Enum. Dipterocarpaceæ, *Journ. Linn. Soc.* 31 (1895), 27) has separated the 2 species on somewhat slender grounds,' as Talbot says. Brandis (Ind. Trees, 1911, 65) has retained the separation, and Gamble and Troup have followed him :

1. **Dipterocarpus indicus**, Bedd. For. Report (1864–65), 17, Fl. t. 99 ; Brandis Journ. Linn. Soc. 31 (1895), 27 ; Ind. Trees (1911), 65 ; Gamble Fl. Madras (1915), 81; Troup Ind. Silvic. i (1921), 37.—*Dipterocarpus turbinatus*, This.-Dyer in Hook. f. F.B.I. i, 295 (*partim*); Cke. i, 84 (*partim*); Talbot For. Fl. Bomb. i (1909), 108 (*partim*).

Description : Differs from *D. turbinatus* in the following points : Leaves subglabrous ; petioles longer, ½ to ¼ the length of the blades, secondary nerves less numerous, 10–15 pairs ; flowers white ; tube of fruiting calyx smooth.

Locality : Konkan (Stocks).—From N. Kanara southwards in the evergreen rain-forests of the Ghats (Talbot) ; Gersoppa Ghat (Talbot !).

Distribution : The W. Ghats from N. Kanara southwards to Travancore in evergreen forests up to 3,000 ft.

D. turbinatus is found in the Andamans, Cachar, Tipperah, Chittagong hills and Burma, extending into Siam and Cochinchina.

Shorea, Roxb. (Cke. i, 85).

Species about 90.—Tropical Asia and Malaya. 1 species in the Pres.

Shorea, Talura, Roxb. Hort. Beng. (1814), 93 ; Cke. i, 85.

Locality : N. Kanara : In the Sirsi taluka scattered throughout the mixed deciduous monsoon-forests near the Mysore frontier (Talbot).

Distribution : Forests of the E. Ghats and Deccan in Cuddappah, N. Arcot, Anantapur, Mysore, and Salem, up to 3,000 ft. W. Ghats in N. Kanara, Malabar, Coimbatore and Madura (ex Gamble).

Hopea, Roxb. (Cke. i, 85).

Species 46.—Tropical Asia and Malaya, one in New Guinea.

1. **Hopea Wightiana,** Wall. Cat. (1828), 6295 ; Cke. i, 86 ; Gamble Fl. Madras (1915), 82 (*partim*).

Gamble l. c. united *H. glabra* W. & A. Prodr. 85 with *H. Wightiana*, but soon afterwards, on receiving fresh material from India, came to the conclusion that Wight and Arnott had, quite correctly, separated the 2 species. (See Kew Bull. (1924) 235).

Wight's figure (Ill. t. 37) which was reproduced by Brandis and Gilg in Engl. & Prantl Pflanzenf. iii, pt. 6, 261, fig. 121 should not be cited here because it shows a different leaf-nervation.

Distribution : W. Peninsula : Evergreen forests from the Konkan southwards to Tinnevelly.

VATERIA, Linn. (Cke. i, 86)

Species 3, one in Ceylon, one in the Seychelles.

1. **Vateria indica,** Linn. Sp. Pl. (1753), 515 ; Cke. i, 86.

Distribution : Western India : From N. Kanara to Travancore up to 3,500 or 4,000 ft., chiefly in evergreen forests, but occasionally along rivers in deciduous forests. In Coorg both in the Ghat forests and east of the Ghats up to 3,500 ft., in the latter locality always in evergreen forest (Troup).

MALVACEAE (Cke. i, 88).

Species about 800.—Warm and temperate regions.

ALTHAEA, Linn. (Cke. i, 89).

1. **Althaea Ludwigii,** Linn. Mantiss. (1767), 98 ; Cke. i, 89.

Locality : Add : *Sind :* Larkana (Sabnis B471 !) ; Sehwan, Kalar soil (Sabnis B172 !).

Distribution : N. W. India, Punjab, Sind, W. Asia, Mediterranean region, S. Africa.

MALVASTRUM, A. Gray (not in Cooke).

Herbs or shrubs. Leaves entire or lobed. Flowers axillary or in a leafy terminal spike ; bracteoles 3, narrow. Calyx cup-shaped, 5-parted. Petals longer than the sepals. Staminal tube bearing anthers on the outside up to the top, with no sterile teeth. Ovary five or more-celled, styles as many as the carpels ; stigmas capitate. Ripe carpels separating from a short torus, indehiscent, 1-seeded, beaked or not. Seeds ascending.

Species about 60.—American and S. African, except two which are cosmopolitan in the tropics.

1. **Malvastrum coromandelianum,** Garcke in Bonpland. v (1857), 297.—*M. tricuspidatum*, A. Gray Pl. Wright (1852), 16.—*Malva tricuspidata*, Ait. Hort. Kew. ed. ii, iv, 210.—*M. coromandeliana*, Linn. Sp. Pl. 687.

An erect branching herb or undershrub, 2-3 feet high. Stem, petiole and main nerves on the lower surface of the leaf stellately hairy, with the hairs few-branched, ascending or descending ; hairs on the blade often simple. Leaves up to 6·5 cm. long, ovate or ovate—lanceolate, irregularly toothed, 5-nerved at the base, nerves impressed above, prominent beneath ; petiole up to 18 mm. long, not swollen near the base, flattened or slightly channelled above, densely hairy ; stipules 5 mm. long, linear, hairy. Peduncles 0-12 mm. long. Bracteoles 3, linear, about half the length of the calyx. Calyx campanulate, cleft about half-way down ; lobes 5, triangular, acute. Corolla 12 mm. across, pale-yellow, exceeding the calyx. Staminal tube antheriferous to the top without sterile teeth. Styles as many as carpels ; stigmas capitate. Carpels 8-12, reniform with 3 projecting spines, bristly between the spines.

Locality : Konkan : Bombay (Hallberg !).—*Deccan :* Poona (Ezekiel !). A weed of roadsides and waste places.

Distribution : A native of America, introduced into India and now found in the Madras and Bombay Presidencies, the Punjab and the United Provinces, Orissa, Bengal.

SIDA, Linn. (Cke. i, 91).

Species about 120.—Mostly tropical weeds ; most numerous in America. Cooke describes 7 species. I add *S. schimperiana*, Hochst.

Note : Parker remarks rightly that the position of the joint to the peduncles is not an absolutely reliable character.

1. **Sida veronicaefolia,** Lam. Encycl. (1785), 5 ; Cke. i, 92.—*S. humilis*, Cav. Diss. v, 277 ; Mast. in Hook. f. F.B.I. i, 322.

Locality. Add : *Konkan :* Bombay (Blatter !). A weed of waste places

2. **Sida glutinosa**, Cav. Diss. i (1785), 16, t. 3, fig. 8 ; Cke. i, 92 ; Haines Bot. Bih. & Or. 59.—*S. mysorensis*, W. & A. Prodr. 59 ; Mast. in Hook. f. F.B.I. i, 322.—*S. urticæfolia*, W. & A. Prodr. 59.

3. **Sida schimperiana**, Hochst. in Rich. Fl. Abyss. i, 66.—*S. cuneifolia*, Roxb. Fl. Ind. iii, 170.—*Dictyocarpus truncatus*, Wight in Ann. Sc. Nat. ser. 2, xi, 169.—*Roedleia truncata*, W. & A. Prodr. 66 (*non* DC.).—*Melochia truncata*, Wall. Cat. no. 1196K.

Description : A woody undershrub ; rootstock thick. Branches repeatedly forked, intricate, decumbent or erect. Leaves oblong, retuse, entire, base cuneate, 12 mm. long, sparingly covered with stellate hairs ; petiole very short. Flowers solitary, axillary, shortly petioled. Sepals 5, connate below the middle in a cup-shaped tube. Petals pink. Carpels 5, subglobose, ultimately dehiscing along the inner edge, beaks short, connivent.

According to Gamble the carpels number 6-10.

Locality : S. M. Country : Yekovigi, Dharwar Distr. (Sedgwick !).

Distribution : Madras Pres. : East Coast Districts at Madras, S. Arcot ; Carnatic, Deccan, Abyssinia, S. Africa.

4. **Sida spinosa**, Linn. Sp. Pl. (1753), 683 ; Cke. i, 92.—*S. alba*, Linn. Sp. Pl. ed. ii, 960.—*S. alnifolia*, Linn. Sp. Pl. 684.

Cooke says that the carpels are 3 (rarely 6). I have always observed 5.

According to Muschler this plant derives its name *spinosa* from the fact that the stipules when falling off leave a prominent tubercular base, more distinct in this than in any other species, although the character is even here not constant.

Parker in his Flora of the Punjab (p. 34) distinguishes 2 forms which can also be seen in the Bombay Presidency. One has the leaves cuneate at the base (*S. alba*, Linn.), the other cordate (*S. alnifolia*, Linn.). It is not always easy to distinguish the former from certain forms of *S. rhombifolia*, except by its thin-walled carpels and peduncles jointed very high up. The latter looks very much like *S. cordifolia*, but can be made out by its 5 carpels.

Locality : Add : *Sind :* Mirpur Sakro, Bohara, Gholam (Blatter & McCann !).—*W. Khandesh* (Blatter !).—*Konkan :* Salsette (Blatter !).

Distribution : Tropical and subtropical regions of both hemispheres.

5. **Sida grewioides**, Guill. Perr. & A. Rich. Fl. Senegamb. i (1830), 71.

The corolla is white or yellow. The carpels are hoary.

Locality : Add : *Sind :* Hyderabad, rocky plateau (Sabnis B243 !) ; Gharo, Kullan Kote Lake, Tatta Tombs (Blatter & McCann !).—*Cutch* (Blatter !).

Distribution : Hassar, W. Rajputana, Sind, Cutch.—Arabia, tropical Africa.

6. **Sida acuta**, Burm. Fl. Ind. (1768), 147 ; Cke. i, 93.—*S. carpinifolia*, Linn. f. Suppl. (1781), 307 ; Mast. in Hook. f. F. B. I. i, 323.

Leaves lanceolate to obovate-lanceolate; 3-5-nerved at the base, secondary nerves 5-8, extending nearly to the margin. Carpels 5-10.

Locality : Add : *Konkan :* Bombay (Blatter !) ; Uran in Bombay Harbour (Blatter !).—*W. Ghats :* Khandala (Blatter & McCann !) ; Panchgani (Blatter !).

Distribution : Hotter parts of India.—Tropics generally.

7. **Sida rhombifolia**, Linn. Sp. Pl. (1753), 684 ; Parker Fl. Punjab 35.

Description : A small erect undershrub. Branches rough with stellate hairs. Leaves very variable in shape, up to 5 cm. by 18 mm., glabrous or subglabrous above, grey pubescent or hoary beneath, coarsely dentate towards the tip, entire towards the base, 3-5-nerved. Petiole up to 6 mm. long, pubescent, swollen in the upper third. Pedicels axillary or crowded towards the ends of the branches. Calyx 5-angular, hairy ; lobes triangular, acuminate. Corolla yellow or white, 8-12 mm. across. Carpels 7-10 with 2 short awns. Seeds smooth, black.

The leaves, the relative length of the pedicels, the position of the joint and the length of the carpellary awns are most variable. and the many varieties which have been made are better considered as so many forms to which many others might be added.

a. Forma **retusa** ; var. *retusa*, Mast. in Hook. f. F. B I. i, 324.—*Sida retusa*, Linn.—Leaves obovate, retuse, or truncate, dark green and glabrous above, more or less tomentose beneath, pedicels equalling, longer or shorter than the petiole, jointed above the middle. Carpellary awns short.

Locality : Gujarat : Petlad (Woodrow !).—*Konkan :* Very common (Dalzell, Stocks) ; Collem (Goa) ; Bombay (Blatter !) ; Salsette (Blatter !) — *W. Ghats :* Igatpuri (Blatter & McCann !) ; Khandala (Blatter !) ; Poona (Woodrow !) ; Panchgani (Blatter !).—*S. M. Country :* Belgaum (Ritchie) ; Dharwar (Cooke !).

b. Forma **rhomboidea** ; var. **rhomboidea**, Mast. in Hook. f. F. B. I. i, 34.—*S. rhomboidea*, Roxb. Hort. Beng. 50.—Leaves rhomboid-lanceolate, serrate, hoary beneath. Pedicels more than half the length of the leaves, jointed at the base.

Locality : W. Ghats : Khandala Ghat, Satara Dist. (McCann !).

Distribution : A weed of waste places, throughout the tropics of both hemispheres.

8. **Sida cordifolia,** Linn. Sp. Pl. (1753), 684 ; Cke. i, 94.

Base of leaf 5-7-nerved. Petioles swollen at the top. Calyx 10-angled.—Resembles an *Abutilon.*

KYDIA, Roxb. (Cke. i. 94).

1. **Kydia calycina,** Roxb. Hort. Beng. (1814), 51.

Distribution : Tropical Himalaya from the Indus eastwards, Burma, Satpuras, W. Peninsula along the Ghats, Konkan and N. Kanara in deciduous forests, Deccan hills of the Poona District, in the Madras Presidency in most districts of the N. Circars and Deccan in deciduous forests, scarce on the W. Coast.

ABUTILON, Tournef. (Cke. i, 95).

Cooke describes 11 species. Another species is here added (*Abutilon Theophrasti*) and the names of *A. glaucum* and *A. hirtum* are being substituted for *A. muticum* and *A. graveolens.*

1. **Abutilon polyandrum,** W. & A. Prodr. (1834), 55 (*non* G. Don) ; Cke. i, 95.

Locality : Add : *Sind :* Indus Delta (Blatter & McCann !).—*W. Ghats* : Khandala (McCann !) ; Purandhar (Blatter !) ; Panchgani (Blatter !).

Distribution : N. W. India, tropical Himalaya, Burma, E. Ghats, Ganjam to Godavari, W. Ghats of the Bombay Presidency and from Mysore to the Pulneys.—Ceylon, Java, S. tropical Africa.

2. **Abutilon Ranadei,** Woodr. & Stapf in Kew Bull. (1894), 99 ; Cke. i, 96.

Distribution : So far endemic in the Konkan.

3. **Abutilon indicum,** Sweet Hort. Brit. i (1827), 54 ; Cke. i, 96.

Erect, up to 3 m. high and 2·5 cm. diam., stem woody when old. Base of leaves 7-9-nerved. Seeds minutely stellately hairy.

Locality : Add : *Cutch* (Blatter !).—*Sind :* Mirpur Sakro (Blatter & McCann D455 !).

Distribution : Throughout tropical India (also Mt. Abu and desert of W. Rajputana).

4. **Abutilon asiaticum,** G. Don Gen. Syst. i (1831), 503 (not of W. & A. Prodr.) ; Cke. i, 96.

Description : Herbaceous or somewhat woody below, densely pubescent. Leaves ovate, cordate, acute or acuminate, serrate, slightly hairy and rugose above, velvety and with prominent veins beneath, 5-10 cm. long ; petioles 3-4 cm. long. Stipules linear, deflexed. Pedicels stout, longer than the petiole, jointed near the flower. Flowers yellow, 5 cm. across, orange-yellow. Calyx densely clothed with long woolly hairs, lobes oval, acuminate, 3-veined, ultimately deflexed. Ripe carpels about 20, hispid, scarcely longer than the calyx ; awns short, erect.—(According to Trimen, the ripe carpels are never awned in Ceylon).

Locality : Cutch (Blatter !).—*Gujarat :* Perim Island (Blatter !).—*W. Khandesh* (Blatter !).

Distribution : E. Coast in Chingleput Dist., W. Peninsula.—Ceylon, tropics of both hemispheres.

5. **Abutilon bidentatum**, Hochst. ex A. Rich. Fl. Abyss. i (1847), 68: Cke. i, 96. Very much like *A. indicum*, but can be distinguished by the stem being usually green right down to the base and by the smaller carpels having more prominent and spreading tips. Parker has observed that in *A. bidentatum* the carpels usually dehisce before breaking away from the central axis, whilst in *A. indicum*, the carpels usually break away before dehiscence has taken place.

Locatity: Sind (Stocks).—*Konkan:* Salsette (Blatter !).

Distribution: Punjab, Sind, desert of W. Rajputana, Konkan.—Afghanistan, Arabia, Egypt, tropical Africa.

6. **Abutilon glaucum**, Sweet Hort. Br. ed. i (1827), 54; Blatter Fl. Arabica (1919), 79.—*A. muticum*, Sweet l.c. ed. ii (1830), 65: Cke. i, 97; Parker Fl. Punjab (1918), 38.—*A. muticum*, Webb. Fl. Aethiop. (1835), 51.—*S. glauca*, Cav. Ic. v (1791), 8, t. 11.—*Abutilon glaucum*, Webb. in Hook. Nig. Fl. 109.—*S. pannosa*, R. Br. in Salt. Abyss. App. 65 (*non* Forsk.).—*A. pannosum*, Webb. Fragm. Fl. Aethiop. 51.— *A. tomentosum*, W. & A. Prodr. 56.

Base of leaf 7-9-nerved.

Locality: Add. *Sind*: Nawabshah, Pad Idan (Sabnis B495 !); Hyderabad Ganja hill (Sabnis B987 !); banks of Phuleli canal (Sabnis B155 !); Narsapur (Sabnis B1135 !); Mirpurkhas (Sabnis B864 !); Jamesabad (Sabnis B929 !); Sanghar (Sabnis B630 !); Umerkot, sandy plains (Sabnis B935 !); Mirpur Sakro in Indus Delta (Blatter & McCann D451 !); Gharo (Blatter & McCann D453 !); Bohara (Blatter & McCann D452 !); Gholam (Blatter & McCann 448 !); Kullan Kote Lake (Blatter & McCann D454 !); Tatta Tombs (Blatter & McCann D450 !).—*W. Khandesh* (Blatter !).—*Konkan:* Salsette (Blatter !).

Distribution: Mediterranean region, tropical Africa, Cape, Egypt, Arabia. Afghanistan, India, Ceylon, Australia.

7. **Abutilon hirtum**, G. Don Gen. Syst. i (1785), 503; Gamble Fl. Madras (1915), 91.—*A. graveolens*, W. & A. Prodr. (1834), 56; Mast. in Hook. f. F.B.I. i, 327; Cke. i, 97.—*A. graveolens* var. *hirtum*, Mast. l.c.—*Sida graveolens*, Roxb. Hort. Beng. 50.—*Abutilon hirtum*, W. & A. Prodr. (1834), 56.—*Sida hirta*, Lam. Dict. i, 17.

Description: A shrub, 1–2 m. high. Branches covered with minute glandular pubescence mixed with long white spreading hairs. Leaves 5–7.5 cm. long, orbicular-cordate, sometimes lobed, abruptly acuminate, velvety on both sides; petiole 2·5–5 cm. long. Stipules linear-falcate, reflexed, deciduous. Pedicels as long as the petioles, jointed above the middle. Flowers large, orange-coloured with a darker centre, becoming pink when old, ultimately reflexed. Calyx-lobes ovate, acuminate, densely pubescent. Petals obcordate. Carpels 15–20 or more, rounded (not acute as has Cooke), hairy, not awned, about as long as the enlarged calyx. Carpels 2–3 seeded. Seeds with minute, shining, stellate hairs.

Distribution: Tropical Africa, Arabia, Baluchistan, India, Malaya, Australia.

8. **Abutilon crispum**, G. Don Gen. Syst. i (1785), 502.

Distribution: S. M. Country, Deccan from Hyderabad southwards, Coromandel Coast.

9. **Abutilon ramosum**, Guill. Perr. & A. Rich. Fl. Senegamb. i (1830), 68; Cke. i, 98.

According to Parker, the carpels dehisce but remain attached to the axis, the whole fruit breaking off at the joint on the pedicel.

Locality: Add: *Cutch* (Blatter !).—*Konkan:* Bombay (Blatter !).

Distribution: N. W. India, Mt. Abu, Sind, Cutch, Gujarat, Konkan.—Arabia, tropical Africa.

10. **Abutilon fruticosum**, Guill. Perr. & A. Rich. Fl. Senegamb. i (1830), 70; Cke. i, 98.

Locality: Add: *Cutch* (Blatter !).

Distribution: Punjab, Rajputana Desert, Sind, Baluchistan.—Arabia, Palestine, tropical Africa, Canaries, Java.

11. **Abutilon cornutum**, T. Cooke in Fl. Bombay i, 98.

Distribution: Sind, Desert of W. Rajputana (Blatter !).

12. **Abutilon Theophrasti**, Medic. Malv. (1787) 28; Blatter Fl. Arab. (1919) 80. —*Sida Abutilon*, Linn. Sp. Pl. (1753), 963; DC. Prodr. i, 470; Roxb. Fl. Ind.

iii, 178.—*Abutilon Avicennae*, Gaertn. Fruct. ii (1791) 251, t. 135; Boiss. Fl. Or. i, 856; Rchbch. Ic. v, fig. 4832; Mast. in Hook. f. F.B.I. i, 327.

The oldest specific name is *Abutilon* (1753), but according to Article 55 of the Vienna Code of Nomenclature, 'specific names must be rejected when they merely repeat the generic name.' The second oldest specific name is *Theophrasti*.

Description : Annual, herbaceous, covered for the most part with fine down, intermingled with a few villi. Leaves 7–10 cm. long, orbicular-cordate, acuminate, dentate, on both surfaces villous or hispid along the nerves. Petiole 7–8 cm., hispid. Stipules large, oblique, broadly ovate-lanceolate. Inflorescence a terminal, ultimately leafless panicle; pedicels short, solitary, axillary, jointed below the middle. Calyx hispid, deeply 5 parted nearly to the base; segments ovate-lanceolate. Petals yellow, hardly exceeding the sepals. Staminal tube very short. Ripe fruit cylindrical, truncate, umbilicate, longer than the persistent calyx. Carpels 15–20, oblong, truncate, hispidulous or pubescent, dehiscing along the dorsal suture, each 3-seeded, with 2 long, horizontal spreading ciliolate awns. Seeds covered with tufts of stellate hairs.

Locality : Sind (ex Masters).

Distribution : N. W. India, Sind, Kashmir, Bengal.—Arabia, Egypt, Mediterranean, S. Eastern Europe. Naturalized in many parts of Asia, Africa and America.

URENA, Linn. (Cke. i, 99).

1. **Urena lobata**, Linn. Sp. Pl. (1753), 692; Mast. in Hook. f. F.B.I. i, 329 *excl. U. palmata ;* Cke. i, 100; Britton in Addisonia 10 (1925), 19, pl. 330.

Locality : Add : *Konkan :* Uran (Hallberg !); Salsette (Blatter !).

Distribution : All tropical countries. A weed of waste places, forest clearings and roadsides.

2. **Urena sinuata**, Linn. Sp. Pl. (1753), 692; Cke. i, 100.—*U. lobata*, Linn. var. *sinuata*, King in Journ. As. Soc. Beng. lx, 2 (1891), 43.

Locality: Add : *Konkan :* Bombay (Blatter !); Salsette (Blatter !).—*Deccan:* Igatpuri (Blatter and McCann !); Khandala (Blatter !).

PAVONIA, Cav. (Cke. i, 101).

See E. Ulbrich. Monographie der afrikanischen Pavonia Arten nebst Ubersicht über die ganze Gattung. Bot. Jahrb. 57 (1920/21), 54–184.

Cooke describes 6 species. I retain them, except that the name of *P. glechomaefolia* will be changed into *P. procumbens*.

1. **Pavonia procumbens**, Boiss. Fl. Or. i (1867), 837.—*Lebretonia procumbens*, Wall. Cat. 2688: Wight Ic. t. 4; W. & A. Prodr. i, 47.—*Pavonia glechomifolia*, Garcke in Schweinf. Beitr. Fl. Aethiop. (1867), 54; Cke. i, 101.—*Lebretonia glechomaefolia*, A. Rich. Fl. Abyss. i, (1847), 54.

Locality : Add : *Cutch* (Blatter !).

Distribution : N. W. India, Sind, Cutch, Circars, Deccan, Carnatic, Burma —Ceylon, Arabia, tropical Africa.

2. **Pavonia arabica**, Steud. Nom. ed. 2 (1841), 279 (*nomen*) *;* Boiss. Fl. Or. ! (1867), 837.

Locality : Add : *Cutch* (Blatter !).

Distribution : Sind, Cutch, W. Rajputana.—Arabia, Abyssinia.

3. **Pavonia zeylanica**, Cav. Diss. 3 (1737), 134, t. 48, fig. 2; Cke. i, 102.

Distribution : N. W. India, W. Rajputana, Sind, W. Peninsula, Circars and Carnatic from the Godavari southwards.—Ceylon, tropical Africa, Mauritius.

4. **Pavonia odorata**, Willd. Sp. Pl. iii (1800), 837; Cke. i, 102.

Flowers sweet-scented. Sepals lanceolate. Corolla pale pink or white, twice the length of the calyx. Carpels gibbous on their backs, wingless, unarmed, dehiscent.

Locality : Add : *Sind :* (exMasters).

Distribution : N. W. India, Sind, W. Rajputana, Konkan, S. M. Country, N. Circars, Deccan, Carnatic, Burma—Ceylon, East tropical Africa.

SENRA, Cav. (Cke. i, 103).

1. **Senra incana**, Cav. Diss. 2. (1786), 83, t. 35, fig. 3 (*Serra*), 104 (*Senra*).

Locality.—Add : *Sind :* Gizri sands (Sabnis B779 !); Manora Isl. (Sabnis B822 !).—*Cutch* (Blatter !).—*Kathiawar :* Dwarka (Börgesen).

Distribution : Sind to Gujarat.—Arabia, Somaliland, Sennar. Abyssinia Kordofan.

HIBISCUS, Linn. (Cke. i, 105).

Cooke describes 23 indigenous and 3 cultivated species.

The following names given by Cooke have been changed : *Hibiscus collinus* into *H. platanifolius*, *H. tetraphyllus* into *H. Manihot*. *Thespesia macrophylla*, Blume has been put under *Hibiscus*.

1. **Hibiscus Trionum**, Linn. Sp. Pl. (1753), 697 ; Cke. i, 105.
Distribution : W. Himalaya, from Kashmir to Simla, Bengal, Sind, Konkan, Deccan, Anantapur, Mysore, Coimbatore and Nilgiris, common on black cotton soil.—S. Europe and hotter parts of the Old World.

2. **Hibiscus surattensis**, Linn. Sp. Pl. (1753), 696 ; Cke. i, 105.
Locality : Add : *Konkan :* Karanja Isl. (Blatter !) ; Bombay (Blatter !).
Distribution : Delhi, Konkan, W. coast from N. Kanara to Tinnevelly, Bengal to Penang and Ceylon.—Tropical Asia, Australia, Africa.

3. **Hibiscus furcatus**, Willd. Enum. (1809), 736 ; Cke. i, 106.
Locality : Add : *Konkan :* Penn (Blatter !).
Distribution : Konkan, S. M. Country, W. Coast and W. Ghats from Malabar and Nilgiris to Travancore, up to 3,000 ft.

4. **Hibiscus radiatus**, Cav. Diss. 3 (1787), 150, t. 54, fig. 2 ; Cke. i, 106.
Locality : Only one specimen has been observed on this side of India viz. on the Phunda Ghat. This is strange considering the geographical area of the species. Was Ritchie's plant correctly named ?
Distribution : Sikkim, Khasia Mts. Ava, Martaban, Malaya.

5. **Hibiscus hirtus**, Linn. Sp. Pl. (1753), 694; Cke. i, 106.
Masters (in Hook. f. F.B.I., i, 335) says that the leaves have a 'large gland on the under side of the midrib.' Duthie (Fl. Upp. Gang. Pl. i, 89) speaks of a 'linear gland.' Gamble, too, mentions (Fl. Madras 95) 'a large gland on the midrib beneath.' Haines (Bot. Bih. & Or. 67) says that the leaves have often a gland on the midrib beneath, and Cooke (l. c.) 'cannot find the large gland on the underside of the midrib mentioned by Masters.' Parker (For. Fl. Punjab 40) does not mention the gland at all.
Locality : Add : *W. Khandesh* (Blatter !).—*Konkan :* Penn (McCann !).—*W. Ghats :* Khandala (Blatter & McCann !).
Distribution : Punjab, Khandesh, Konkan, Deccan, N. Circars in the Godavari District.—Java.

6. **Hibiscus micranthus**, Linn. f. Suppl. (1781), 308; Cke. i, 107.
Locality : Add : *Cutch* (Blatter !).—*W. Ghats :* Khandala (Blatter !).
Distribution : Hotter parts of India from N. W. India eastwards and southwards to Ceylon (W. Rajputana, Mt. Abu).- Arabia, tropical Africa.

7. **Hibiscus intermedius**, A. Rich. Fl. Abyss. i (1847), 58 ; Mast. in Hook. f. F.B.I. i, 336 ; Cke. i, 107.
Var. **aristaevalvis**, Hochr. in Ann. Conserv. Jard. Bot. Genève iv (1900), 94; Blatter Fl. Arab. 82.—*Hibiscus aristaevalvis*, Garcke in Bot. Zeit. vii (1849), 849.—*H. trionoides*, Hochst. Pl. Schimp. Abyss. (1853), n. 497.
Distribution : Sind, Kathiawar—Arabia, tropical Africa.

8. **Hibiscus lobatus**, O. Ktze. Rev. Gen. iii (1898), 19.—*Solandra lobata*, Murr. in Comm. Götting. vi, 1783–84 (1785), 20.—*Laguna lobata*, Wild. Sp. Pl. iii 733.—*Hibiscus Solandra*, L'Hér. Stirp. i, (1784), 103, t. 49 ; Mast. in Hook. f. F.B.I. i, 336 ; Cke. i, 107.
Description : An erect annual, 30–75 cm. high. Stems slightly branched, pubescent or somewhat hispid. Lower leaves long-petioled, ovate, upper more or less deeply 3-lobed, uppermost sometimes 3-foliolate, all cordate, acute, coarsely serrate, hairy on both sides. Stipules setaceous. Pedicels 2·5–4 cm. long, 1-flowered, jointed near the top, arranged in a loose leafless terminal raceme. Bracteoles linear, minute or usually absent. Flowers 12–18 mm. across, distant, white or yellow or pink. Calyx divided to about the middle, pubescent; lobes lanceolate, prominently 3-nerved. Petals obliquely obcordate. Capsule ovoid, pointed, hairy at the top, not exceeding the calyx. Seeds blackish, tubercled.

Locality : Add : *Konkan :* Salsette (Blatter !).
Distribution : N. W. India to Sikkim, Burma, Mt. Abu, Konkan, S. M. Country, W. Ghats and Coast from S. Kanara to Tinnevelly, N. Circars in Vizagapatam and Godavari.—Ceylon, tropical Africa.

9. **Hibiscus platanifolius**, Sw. Hort. Brit. ed. i (1827), 51; Gamble Fl. Madras (1915), 98.—*Pavonia platanifolia*, Willd. in Ges. Naturf. Fr. Berl. Mag. iv (1810), 220.—*Hibiscus collinus*, Roxb. Hort. Beng. (1814), 51; Cke. i, 108.
Description : A small tree up to 90 cm. girth. Shoots tomentose and twigs hoary with stellate hairs. Leaves 10–16 cm. long and broad, deeply 3-lobed with shallow cordate base, sometimes 5-lobed, hairy beneath and thinly so above with simple and stellate hairs, lobes acuminate or caudate, sinuate-dentate or sublobed; primary nerves 5–7 and secondary raised beneath. Petioles 7·5–11 cm. long. Flowers 5–7·5 cm. diam., pink with dark centre. Pedicels 5–11 cm. long, axillary, jointed 15–17 mm. from the top. Involucral bracts 5 (Masters has 8–10), leaf-like, free, lanceolate, about equalling the calyx. Calyx pubescent, divided to below the middle; segments ovate, acute, 1-nerved. Corolla pink with dark centre. Capsule 18 mm. diam., globose, slightly pointed, 5-celled and—angled, covered with fulvous hairs, loculi with long bristles within. Seeds grey-black, subglobose, glabrous.
Locality : Add : *Konkan :* Bombay (Blatter !).
Distribution : Konkan, Salem, Tinnevelly, N. Circars in Vizagapatam, Cuddapah forests, often cultivated in gardens.—Ceylon.

10. **Hibiscus lunariifolius**, Willd. Sp. Pl. iii (1800), 811; Cke. i, 108.
Distribution : Konkan, W. Ghats from Mysore southwards up to 3,000 ft., E. Carnatic, Burma.—Ceylon, Arabia, Upper Guinea, Abyssinia, Sennar, Lake Ngami, Mozambique.

11. **Hibiscus panduræformis**, Burm. Fl. Ind. (1768), 151, Cke. i, 108.
Locality : Add : *Cutch* (Blatter !).—*W. Khandesh* (Blatter !).—*Konkan :* Bombay (Blatter !); Penn (McCann !).
Distribution: Hotter parts of India from N. W. India to Burma and Ceylon.—Australia, tropical Africa.

12. **Hibiscus vitifolius,**, Linn. Sp. Pl. (1753), 696; Cke. i, 109.
The information regarding the number of bracteoles varies a good deal: Cooke gives 7–12, Haines 6–12, Masters 8–12, Duthie 5–8.
Distribution : Hotter parts of India from the Punjab to Ceylon. Tropical Africa, Australia.

13. **Hibiscus cannabinus**, Linn. Syst. Nat. (1759), 1149; Cke. i, 109. Apparently a native of Africa.

14. **Hibiscus caesius**, Garcke in Oester. Bot. Zeit. (1849), 850 and in Peters Reise Mossamb. 125; Cke. i, 109.—*H. Gibsoni*, Stocks in Harv. *et* Sond. Fl. Cap. ii, 587; Mast. in Hook. f. F. B. I. i, 339.
Locality : Add : *Sind* (Stocks).—*Konkan* (ex Duthie).—*W. Khandesh* (Blatter !).
Distribution : Punjab, Sind, Khandesh, Deccan, Konkan.—Afghanistan, S. tropical Africa, N. Australia.

15. **Hibiscus punctatus**, Dalz. in Dalz. & Gibs. Bomb. Fl. (1861), 20; Cke. i, 110.
Distribution : Sind, Gujarat, Multan.

16. **Hibiscus, ficulneus**, Linn. Sp. Pl. (1753), 695; Cke. i, 110.
Corolla white with a pink centre. The capsule is covered with viscid points when green.
Locality : Add : *E. Khandesh :* Bhusawal (Blatter !).
Distribution : Punjab and Bengal to S. India (Khandesh, Circars, Deccan, Carnatic).—Ceylon.

17. **Hibiscus Manihot**, Linn. Sp. Pl. 696; Gamble Fl. Madras 97.—*H. tetraphyllus*, Roxb. Hort. Beng. (1814), 52; Cke. i, 111.
Locality : Add : *Konkan :* Bombay (Blatter !).—*W. Ghats :* Khandala (Blatter !).
Distribution : Bengal, Mt. Abu, Gujarat, Konkan, W. Ghats, W. Coast from S. Kanara to Travancore.

18. **Hibiscus angulosus**, Steud. Nom. ed. 2, i (1841), 758; Mast. in Hook. f. F. B. I. i, 341 (*partim*); Cke. i, 111 (*partim*).—*Abelmoschus angulosus*, Wight Ic. t. 951; Wight & Arn. Prodr. 53 (*partim*). [Dunn (Kew Bull. (1914), 324), has separated *H. setinervis* from *H. angulosus*, Mast. I have not seen this species. Its occurrence in the Presidency is doubtful.]

Distribution : W. Ghats, in the higher ranges from S. Kanara to Travancore, up to 8,000 ft., usually near streams (Gamble).

19. **Hibiscus Abelmoschus**, Linn. Sp. Pl. (1753), 696; Mast. in Hook. f. F. B. I. i, 342 (*excl. H. sagittifolio*, Kurz *qui est species distincta*); Cke. i, 112.—*Abelmoschus moschatus*, Medik. Malv. 46.—*Hibiscus rugosus*, Mast. l. c.—*Abelmoschus rugosus*, W. & A. Prodr. 53.

20. **Hibiscus esculentus**, Linn. Sp. Pl. (1753), 696; Cke. i, 112.—*Abelmoschus esculentus*, (Linn.) Moench Meth. 617.

See S. P. Agharkar. On the occurrence of Carpellody in the stamens of *H. esculentus*, Linn. and some abnormalities of the fruit resulting from it. In Journ. Ind. Bot. Soc. v (1926), 17.

21. **Hibiscus tiliaceus**, Linn. Sp. Pl. (1753), 694; Cke. i, 112.—*H. tortuosus*, Roxb. Fl. Ind. iii, 192.—*Paritium tiliaceum*, A. St. Hil. Fl. Bras. Mer. i, 256.

Locality : Add: Bombay (Blatter!).

Distribution : This is, according to Merrill, a species of natural pantropic distribution, grows in all tropical countries along the seashore and has been disseminated in ages past by ocean currents, the seeds being adapted for such dissemination.—See E. D. Merrill. Comments on Cooke's theory as to the American origin and prehistoric Polynesian distribution of certain economic plants especially Hibiscus tiliaceus, C. Philipp. Journ. Sc. 17 (1920), 377-84.

22. **Hibiscus lampas**, Cav. Diss. iii (1787), 154, t. 56, fig. 2.—*Thespesia lampas*, Dalz. & Gibs. Bomb. Fl. (1861), 19.—*Azanaza lampas*, Alef. in Bot. Zeit. xix (1861), 299.—*Thespesia macrophylla*, Blume Bijdr. (1825), 73; Cke. i, 114.

Locality : Add: *W. Khandesh :* Satpuras (Blatter & McCann!).—*Konkan :* Bombay (Blatter!); Salsette (Blatter & Hallberg!).—*W. Ghats :* Khandala (Blatter!).

Distribution : Himalaya up to 4,000 ft., Bengal, Burma, W. Peninsula (Konkan, Kanara, W. Ghats up to 3,000 ft.), N. Circars, Deccan.—Ceylon, Java, E. tropical Africa.

23. **Hibiscus Rosa sinensis**, Linn. Sp. Pl. (1753), 694; Cke. i, 113.

An extremely variable species. There are single and double forms, and as to colour the flowers may be orange, yellow, crimson, bright red, magenta, and parti-coloured.—No fruits produced in India.

Native country Asia, probably China.

24. **Hibiscus mutabilis**, Hook. f. Bot. Mag. t. 6524.

As to habit and foliage, it resembles the preceding species. A tall glabrous shrub with slender drooping branches. Leaves ovate-elliptic, dentate. Bracteoles minute. Flowers pendulous, on long jointed pedicels, red or orange-red. Calyx shortly toothed at the apex, splitting down one side. Corolla 5 cm. across, the recurved petals beautifully and deeply cut. Stamens long exserted. Fruit long, bearing smooth seeds, but apparently not produced in India.—Cultivated in Indian gardens.

A native of E. tropical Africa.

25. **Hibiscus syriacus**, Linn. Sp. Pl. (1753), 695; Cke. i, 114.

The Rose of Sharon.

Corolla lilac-blue with dark purple eye, or rose or purple, usually darker at the base. Pod short, splitting into 5 valves. Very variable, the colours ranging from blue-purple to violet-red, flesh-colour and white. There are also double forms.

The native country is uncertain, probably not Syria, as Linnaeus supposed. Probably indigenous in China.

THESPESIA, Soland. (Cke. i, 114).

Cooke has 2 species: *T. macrophylla*, Blume and *T. populnea*, Soland. The former has been put under *Hibiscus*.

1. **Thespesia populnea,** Soland. ex Correa in Ann. Mus. 9 (1807), 290; Cke. i, 114.—*Hibiscus populneus,* Linn. Sp. Pl. (1753), 694.—*H. populneoides,* Roxb. Hort. Beng. 51.

A tree of the coast forests of India and Burma, largely grown as a roadside tree in tropical regions.

Gossypium, Linn. (Cke. i, 115).

See—

J. A. Todaro. Relazione sui Cotoni coltivati nel R. Orto Botanico di Palermo nell'anno 1876. Palermo 1877.

G. A. Gammie. Indian Cottons. Memoirs of Agr. in India ii (1907).

G. Watt. Wild and Cultivated Cotton Plants of the World. 1907.

J. A. Todd. The World's Cotton Crops. London 1915.

H. J. Denham. Gossypium in pre-Linnean literature. Bot. Mem. [Oxford] 2 (1919), 24 p.

S. H. Prayag. Variations in the *Gossypium negletum* types of Cotton. Proc. 9th Ind. Sc. Congr. (1923), 123.

G. Watt. Gossypium. Kew Bull. (1926), 193-210.

Cooke mentions 4 species and some varieties. In the meantime, Watt has described a new species from Sind: *G. Bakeri.*

1. **Gossypium Stocksii,** Mast. in Hook. f. F. B. I. i, 346; Watt Wild & Cult. Cott. (1907), 73, pl. 6; Cke. i, 115; Watt in Kew Bull. (1926), 194.

This is a wild species which has never been cultivated. According to Watt it has taken no part in the production of the cottons of India.

2. **Gossypium herbaceum,** Linn. Sp. Pl. (1753), 693 (*partim*); Watt Wild and Cult. Cot. 79 and 155–63, pl. 24, 25; Watt in Kew Bull. (1926), 208; Cke. i, 116 (*partim*).

Description: Kew Bull. (1926), 208.

This species does not seem to occur in the Bombay Presidency. The var. *Wightianum* of Cooke, 116 is put under the next species by Watt.

3. **Gossypium obtusifolium,** Roxb. Hort. Beng. 51; Fl. Ind. iii, 183; Watt Wild and Cult. Cott. (1907), 79, 139–43, pl. 19 and 20; Kew Bull. (1926), 202.

Watt gives the following description of the typical form of Roxburgh's supposed Ceylon plant:—

Leaves rotund-oblong, obtuse, base cordate but hardly auriculate, thin, smooth, compact, minutely stellately pilose: lobes more or less ovate-rotund, constricted below and emarginate. Bracteoles half the length of the corolla, ovate, entire or coarsely toothed, not very deeply cordate but prominently veined. Flowers large, convolvulate, yellow, usually with large dark-purple blotches on the claws and a purple tinge on passing to maturity. Calyx irregular with 5 large rounded teeth. Corolla having a short tube, with the petals only slightly attached. Seeds very large, irregular, with a rusty-grey fuzz and the floss poor, reddish-white, woolly. Fruit 3-celled, valves as a rule completely reflexed. (Watt).

The forms which have to be placed under *G. obtusifolium* show, as cultivated plants, 'departures in the inflorescence, which often becomes proliferous; in the bracteoles which remain ovate, never assuming the round-reniform shape seen in *G. herbaceum,* though they frequently become deeply gashed; in the fruit often becoming 4-celled and sometimes opening imperfectly; and the seeds frequently becoming small and numerous with the floss often considerably improved both in length and texture. They are plants that manifest ready adaptation to soil and climate, and are the most valued of the Asiatic Cottons.' (Watt).

Var. **Wightianum,** Watt, Wild and Cult. Cott. (1907), 143–53, pl. 21, 22; Kew Bull. (1926), 203.—*Gossypium herbaceum* var. *Wightianum,* Cke. i, 116 (*partim*).

This is Todaro's *G. Wightianum,* originally described in the Osservazioni su talune Sp. di Cot. (1863) 47. Here he dealt with one plant only but later on (in Relaz. sui Cot. Coltiv. etc. (1877), 141–6, t. iv, f. 1–9) he had several specimens before him and made a combined description, thus confusing the species. 'The main point aimed at, however, was accomplished, namely the separation of the Indian plant from *G. herbaceum,* Linn.' (Watt).

This variety may be recognized according to Watt by the following: Leaves ovate-rotund, often coated with persistent, long shaggy hairs over a short tomentum of stellate hairs, especially on the veins below; lobes 5–7, rarely 3, ovate-oblong, acute to acuminate, with the sinuses often thrown up in folds. Bracteoles sometimes almost free, relatively small, ovate, obtuse or acute, deeply dentate on the upper margin and nerves prominent.

Cultivated in Cutch, Kathiawar, Gujarat, S. M Country.

4. **Gossypium Nanking**, Meyen Reise ii (1836), 323; Watt Wild and Cult. Cott. (1907), 78, 114–24, pl. 15; Kew Bull. (1926), 196.

Var. **Bani**, Watt l. c. 131–4; Kew Bull. (1926), 197.

Description: Twigs, petioles and peduncles pilose and usually purple. Leaves large, thin, softly pilose; lobes undulate. Bracteoles large, thin, membranous, ovate, triangular to oblong-acute, with 3 teeth at the apex, the middle one much the largest and each bracteole having 3 veins usually prominent along the centre. Flowers not much exceeding the bracteoles, yellow, pink or white, usually with purple claws. (After Watt).

Cultivated in S. Kathiawar.

Var. **rubicunda**, Watt Wild and Cult. Cott. (1907), 126–8, pl. 17, 18; Commerc. Prod. Ind. (1908), 580.

Was cultivated in Gujarat.

Var. **Roji**, Watt Wild and Cult. Cott. (1907) 134–7; Commerc. Prod. Ind. (1908), 581.

Cultivated in Gujarat.

5. **Gossypium hirsutum**, Linn. Sp. Pl. ed. 2 (1763), 975; Watt. Commerc. Prod. Ind. (1908), 585.—*G. latifolium*, Murray Comm. Soc. Reg. Gött. vii (1776), 22–5, t. 1; Watt Wild and Cult. Cott. (1907), 183–200, pl. 29–31.—Watt thinks this might possibly be a cultivated state of *G. punctatum*, Sch. and Thon. (*G. jamaicense*, Macf.)

Cultivated in Dharwar and the neighbouring districts.

Var. **religiosa**, Watt Wild and Cult. Cott. (1907), 201–4, t. 32, 33; Commerc. Prod. Ind. (1908), 586.—*G. religiosum*, Linn. Syst. Nat. ii (1767), 462 (*partim*). —*G. religiosum*, Roxb. Fl. Ind. iii (1832), 185–6.

6. **Gossypium barbadense**, Linn. Hort. Upsal. i (1748), 204; Sp. Pl. (1753), 693; Wight Ill. Ind. Bot. i. (1840), 57–64, t. 28B; Cke. i, 117.

7. **Gossypium brasiliense**, Macf. Fl. Jam. i (1837), 72; Watt Wild and Cults Cott. (1907), 295-315, pl. 49, 50.—*G. religiosum*, Lam. *et auctor.* (*non* Linn.),—*G. barbadense* var. *brasiliense*, Cooke Fl. Bomb. i, 118.—*G. acuminatum*, Roxb. Fl. Ind. iii (1832), 186.

8. **Gossypium arboreum**, Linn. Sp. Pl. (1753), 693; Watt Wild and Cult. Cott. (1907), 77, 81–91, pl. 7, 8; Cke. i, 118.

Locality: In gardens and about temples.

Var. **neglectum**, Watt l. c. 77, 95–108, pl. 10–12; Kew Bull. (1926) 195.

Description: Leaves very hairy, coarse, bullated, rough, furrowed or corrugated; lobes 3, 5 or 7 often with supplementary teeth, linear-lanceolate, undulate, the bottom pair spreading. Bracteoles very large, greatly produced laterally, more than half the length of the corolla. Flowers often 2 together, usually yellow with purple claws.

Cultivated in Gujarat and Kathiawar.

9. **Gossypium Bakeri**, Watt in Kew Bull. (1926), 210.

Description: 'Twigs, petioles and peduncles densely coated with a cinereous tomentum, the hairs of which are matted but not stellate. Leaves thick, ovate, cordate, densely tomentose, less than half cut into 3-lobes; lobes deltoid acute (dentate on the leaves of the young foliage) with the sinuses between the lobes gaping open and the veins entirely hidden within the tomentum. Bracteoles ovate, oblong, acute, quite entire, more than half united below, thin, glabrescent, connivent (in bud closed like a bivalved shell with the margin of the outermost one turned over the others), multinerved, only very minutely cordate. No glands visible either internal or external. Calyx a compact short cup ending in 5 long triangular teeth, hairy on the tips. Corolla, Fruit and Seed not seen.'

Locality : Sind : Near Gharo (C. N. Baker).

'It is undoubtedly a wild species and was found in the Sind desert 5 miles from the nearest field and 50 miles from cotton cultivation. Moreover it does not look as if it could have been cultivated. At all events there is no trace of its influence on any known Indian hybrid.' (Watt).

BOMBACACEAE

Trees, sometimes with bulging stems through excess of water storage. Leaves alternate, simple or digitate, often lepidote, deciduous; stipules deciduous. Flowers hermaphrodite, regular, medium or large, showy. Calyx cup-shaped, closed and valvate in bud, truncate or irregularly 3–5-lobed, with slightly imbricate lobes often subtended by an epicalyx. Petals 5, imbricate, often elongated, sometimes absent. Stamens free or united into a tube, opposite the petals; anthers reniform to linear; pollen smooth. Ovary superior 2–5-celled, free; style simple, capitate or lobed; ovules 2 or more on the inner angle of each cell. Capsule loculicidally dehiscent or indehiscent, the valves rarely falling away. Seeds often embedded in hairs from the wall of the fruit, with little or no endosperm and flat or contorted or plicate cotyledons.

Genera about 21, species about 150.—Widely distributed in the tropics.

See: Bakhuisen van der Brink. Bombacaceae. In Bull. du Jardin Bot. de Buitenzorg. Batavia. 1924.

ADANSONIA, Linn. Sp. Pl. (1753), 1190; Cke. i, 119.

1. **Adanosnia digitata,** Linn. Sp. Pl. (1753), 1190; Cke. i. 119.—*Baobabus digitata*, O. Ktze. Rev. Gen. I (1891), 67.

Description : Cke. l.c.

BOMBAX, Linn. (Cke. i, 119).

Species about 50. Chiefly tropical American.

1. **Bombax ceiba,** Linn. Sp. Pl. 511; Merrill Fl. Manila (1912), 325.—*B. malabaricum* DC. Prodr. i (1824), 479; Cke. i, 120.—*Salmalia malabarica*, Schott and Endl. Melet. (1832), 35.

Description : Cke. i, 120.

Distribution : Throughout the hotter parts of India, Burma, and Ceylon.—Malaya.

Cf. H. M. Chibber. Observations on structure of flower in *Bombax malabaricum*, Proced. 5th Ind. Sc. Congr. (1918) CLXXIII.—C.E.C. Cox. Note on samal or cotton wood. Ind. For. Dept. For. Bull. 44 (1921), 31 p.

2. **Bombax insigne,** Wall. Pl. As. Rar. i (1830), 71; Cke. I, 120.

Distribution : Ghats of the W. Peninsula from the Konkan southwards, Anamalai Hills, Deccan, Burma, Pegu, Andamans.—Cambodia.

According to Troup (Silvic. Ind. Trees, i, 145) the W. Ghat tree is subsp. *genuina*, Prain var. *Wightii* Prain in Journ. As. Soc. Beng. 62 (1893), 67.

A large tree with more or less prickly bark. Leaflets 5-6 or more. Petals red, about 8·5 cm. long. Capsules about 12–18 cm. long by 5 cm. diam.

CEIBA, Medic. Malv. (1787), 15.

(*Eriodendron*, DC. Prodr i (1824), 479; Cke. i, 121).

1. **Ceiba pentandra,** (Linn.) Gaertn. Fruct. ii, (1791), 244, t. 133.—*Bombax pentandrum*, Linn. Sp. Pl. (1753), 511.—*Eriodendron anfractuosum*, DC. Prodr. i (1824), 479; Cke. i, 121.—*E. pentandrum*, Kurz in *Journ. As. Soc.* Beng. xliii, ii (1874), 113; Gamble Fl. Madras (1915), 100.

Distribution : Indigenous in the Andamans, the Malay Archipelago tropical America, but doubtfully so in the W. Peninsula.

WALTHERIA, Linn. (Cke. i, 135, under *Sterculiaceæ*).

Species 30.—Chiefly tropical American, 1 species throughout the tropics.

Cooke mentions *Waltheria indica*, Linn. which should be changed into

1. **Waltheria americana,** Linn. Sp. Pl. (1753) 673.—*W. indica* Linn l. c.

(*To be continued.*)

THE LIONS OF ASIA

BY

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(*With 5 plates and a Map.*)

INTRODUCTION.

It is not my intention in this article to enter into particulars regarding the former distribution of the lion in Europe or Asia or to enumerate all the localities in Mesopotamia, Persia and India whence it has been recorded, because an admirable summary of this subject was published ten years ago by N. B. Kinnear (*Journ. Bom. Nat. Hist. Soc.* 1920, pp. 33–39), and I have very little to add to what he said.

My object is to settle, as far as the tolerably copious literature and deplorably scanty material at my disposal permit, the characters and status of the lion, or lions, of these countries and to discuss the scientific names that have been given to them. And for the sake of convenience I divide the main portion of this article into two sections, the first dealing with the lion of Persia and Mesopotamia, and the second with the lion of India. But there are one or two points of general interest that may be suitably dealt with first.

LIONS, TIGERS AND PANTHERS.

In two recently published papers on Tigers and Asiatic Panthers (*Journ. Bombay Nat. Hist. Soc.*, vol. xxxiii, pp. 505–41, 1929; and vol. xxxiv, pp. 67–82 and 307–36, 1930), I gave my reasons for associating these two species with the lion in the genus *Panthera* and for severing them from *Felis*, and also my reasons for repudiating the view that the distinguishing characters of these great Cats are sufficiently important to justify their ascription to three distinct genera—*Tigris* for the tiger, *Panthera* for the panther, and *Leo* for the lion—a view recently revived in accordance with the superficial modern method of adopting generic titles without attempt at definition.

In the paper on tigers it was also shown that several of the characters usually accepted as infallibly distinguishing the skulls of tigers and lions, notably the length of the nasal bones, break down when large numbers of skulls are examined. Nevertheless, by the combination of a number of characters, the skulls of these two species can always, I believe, be distinguished at a glance by those accustomed to handling them. The lion's skull is typically lower and flatter than the tiger's, has shorter nasal bones, larger anterior nares and a shorter 'waist', i.e., the distance between the parieto-frontal suture and the postorbital processes on the summit of the cranium is less than in a tiger's skull of the same absolute length.

This last difference makes the facial portion of a lion's skull look longer and more massive as compared with the cranial portion. Also in a lion's skull the inner lobe of the upper carnassial tooth is not so well developed. But this lobe is liable to wear down with use and the character seems to fail in oldish tigers. The difficulty of laying down absolute differences arises from the great individual and racial variations in the size, shape, and other characters of tiger's skulls. Lions' skulls, both individually and racially, are less variable. Perhaps the one distinctive feature which holds good is the shape of the lower edge of the mandible. In the lion's skull this is slightly convex in front of the posterior angle, whereas in the tiger's skull the corresponding area is slightly concave. Hence the lion's skull 'rocks' and the tiger's skull rests steady on a flat surface. True, the extent to which a lion's skull 'rocks' is subject to variation; but I have never handled a tiger's skull capable of that movement.

It is well known that newly-born lion cubs are not uniformly tawny in hue like the adults; and it was stated by Lydekker (*Game Animals of India*, p. 293, 1924) that their spotted pattern proves the descent of the lion from a spotted progenitor, like the panther. Unfortunately for this theory, lion cubs are by no means always spotted. Many illustrations in the older natural histories show very definite transverse stripes on the cubs; and several years ago (*Ann. Mag. Nat. Hist.* (7), XX, pp. 436–45, 1907), when discussing this question. I described and figured a lion cub with a very distinct pattern of looped stripes and large rosettes tending to run into lines, a pattern more tigrine than pantherine. If we take this cub as a criterion, it appears to supply evidence that the ancestor of the lion in the matter of pattern stood midway between the panther and jaguar on the one hand and the tiger on the other; and this pattern is strong corroborative testimony of the close kinship between lions, tigers and panthers.

There is one other little point about lion cubs which may here be referred to. It is commonly said, and the statement was repeated by Blanford in his volume on *The Mammals of British India*, that they are born with the eyes open. Sometimes they are; but by no means always, as I know from my experience in the Zoological Gardens, London.

The Manes of Lions.

Very naturally the manes of lions have attracted the notice of sportsmen and naturalists more than any other feature. But although a great deal has been written on the subject, it cannot be claimed that we understand the factors which determine the growth of the mane and the development of black pigment in it in individual lions. Some facts of interest, however, refuting the ideas formerly entertained, that 'black-maned' and 'tawny-maned' lions, and maned and maneless lions are racially distinct types are well-established.

It is well known that the mane is a secondary sexual character typically, but not always acquired gradually by males as they approach maturity. As is usual in such characters, its development is prevented by castration (Jardine, *Nat. Library*, *Felinæ*, p. 120 (note), 1834) and it may be present in females as was shown by Brig.-Genl. R. Pigot who shot a lioness with a small mane in Kenya Colony in 1922 and exhibited its skin before the Zoological Society (*Proc. Zool. Soc.*, 1923). This case is analogous to the growth of small beards in old women and to the appearance of male characters in female game birds and waterfowl in which the ovary atrophies from age or injury.

Maneless and small-maned lions.—Lions which fail to develop any mane may occur in districts where these animals are typically maned. For instance, Patterson's man-eaters of Tsavo were maneless, although the lions of British East Africa carry, as a rule, tolerably good manes; and, as stated later in this paper, maneless lions have been recorded from Bussorah or Basra, although Mesopotamian lions are typically maned.

The lion of Gujerat was originally but erroneously called maneless. After commenting on this misapplication of the epithet by Smee and stating that these lions are smaller-maned than the African, Col. L. L. Fenton (*Jour. Bombay Nat. Hist. Soc.*, xix, p. 10, 1909), explained the circumstance by the home of the Gujerat or Gir lion 'being in a thorny jungle where its mane is bound to suffer, whereas the African lion is more or less a dweller in the plains.' General Rice (*Indian Game*) was, I believe, the founder of this fiction. In the first place, thorns would not pull out a lion's mane. The most they could do would be to comb out hairs on the point of being moulted or already moulted and entangled with the tightly adherent hairs of the mane. Deprivation of thorn-combing no doubt explains the frequently unkempt appearance of the manes of lions in captivity, owing to clumps or mats of shed hair clinging in places. I have never seen the manes of wild-killed lions with similar clogging of the hair. But the fallacy of General Rice's contention is further established by the existence of wholly maneless lions and by the occurrence of well-maned and maneless or almost maneless lions in the same district. Clearly the 'combing' theory will not explain this variation.

Black-maned and tawny-maned lions.—The terms 'black-maned' and 'tawny-maned' have been applied in a very loose sense to lions, but in such a way as to suggest that lions fall into one or the other of these categories. That is not the case. In my experience there is no such thing as a wholly 'black-maned' or a wholly 'tawny-maned' lion. Lions with the blackest manes always have the face surrounded by a tawny fringe. It is on the crest and the areas behind and below the head that the black pigment is developed giving a sharp contrast in colour between the mane and the body and fore legs. On the other hand lions with the tawniest manes almost always show a certain amount of dark pigmentation along the median crest and low down in front of the base of the foreleg. There is every gradation between these types; and 'black' and 'tawny' appear to imply merely a preponderance of one colour or the other in the mane. Furthermore, lions described as 'black-maned' and 'tawny-maned' may be found in the same place as has frequently been recorded.

From the available evidence, therefore, it appears that neither the luxuriance nor the colour of the mane can be regarded as of much importance in the differentiation of races of lions. But it may in the future be found when more extensive observations have been made that on the average the lions from one district may have heavier and blacker manes than those from another.

The elbow-tuft and belly-fringe.—These are also secondary sexual characters associated with the mane. The fringe along the belly is in reality composed of two crests of long hairs which, when well developed, extend from the chest in front almost to the groin behind where they may spread on to the lower part of the front of the thigh. This fringe is present in almost all the old pictures of lions taken from captive specimens ; but it is generally absent or quite small in lions killed nowadays.

As a rule the size of the elbow-tuft corresponds to the size of the mane. In African lions this seems to be the case ; but, as recorded below, it is not the case in the skins of the Asiatic lions I have seen.

The tail-tuft.—Unlike the mane, belly-fringe and elbow-tuft, the tail-tuft is not a secondary sexual character since it is found in the lioness as well as in the lion. It is independent of the factors which foster the growth of the mane and appears to be equally well developed in both sexes. Capt. Smee long ago pointed out that it is unusually large in the Indian lion.

THE EXTERMINATION OF ASIATIC LIONS.

It is a matter of common knowledge that within historic times the lion extended, so far as Europe and Asia are concerned, from northern Greece and Macedonia to western Bengal. In Europe, Asia Minor and Syria it has long been extinct. It may possibly still survive in parts of south Persia and Mesopotamia. At all events during, or just after, the Great War, Major Cheesman, writing to me from Iraq, reported that he and Sir Percy Cox had news of a lioness and cubs not far from their headquarters. They hoped to secure the cubs for the Zoological Gardens, but the project was never fulfilled.

Assuming that the lion is still a member of the Mesopotamian fauna, it is safe to prophesy that it will soon cease to be so. It is equally safe to state that by now it would have disappeared from India but for the enlightened views that led to its protection in the Gir Forest in Kathiawar.

It is reasonable to suppose that the factors which exterminated it in Europe, Asia Minor and Syria and have brought it to the verge of extinction in Mesopotamia and Persia, even if they have not already achieved that end, were the same as the factors which exterminated it over almost the whole of the area it occupied in India. In my opinion there is no reasonable doubt that the main, if not the sole, factor in the case of Europe and south western Asia was man. At all events it was most emphatically not the tiger. My insistence on this fact arises from an article published a few years ago in the *Field*, in which the author cited the practical extermination of the lion in India by the tiger as an item of evidence of the physical superiority of the tiger entitling it to be regarded as the King of Beasts, instead of the lion.

Little, however, can now be achieved by debating what the exterminating agency was. The fact remains that Asiatic lions are now almost things of the past and there is practically no material available to tell us what they were like as wild animals. In fact most of the information I can gather about Mesopotamian and Persian lions is supplied by the observations of authors in the past upon captive specimens. This is an important point to remember.

The Effects of Captivity on Lions.

In former years I had many a talk with F. C. Selous on the differences between wild lions and lions exhibited in menageries. He was firmly convinced that lions in captivity were darker in colour and grew larger manes than lions in their native haunts ; and he saw in the Zoological Gardens full grown lions, caught as cubs near the Sebakwe River, Rhodesia, which he declared to be far more imposing in appearance than any he had himself shot in the same district.

This conviction of Selous', which was published in more than one of his writings, was subsequently confirmed by Hollister (*Proc. U. S. Nat. Mus.* 53, pp. 177–93, 1917), who stated that some young Masai lions after being transported to Washington got noticeably darker the longer they lived and that all of them finally were deeper in tint and more fully maned than the skins of Masai lions shot in the wild. He also showed that owing to the comparative disuse of certain muscles of the neck and jaws, the skulls of these captive lions differed profoundly in many respects from the skulls of the wild specimens. But he by no means exhausted the category of modifications the conditions of captivity impose on lions' skulls. I have seen skulls of menagerie lions differing from typical skulls of wild lions in many more particulars and even more markedly than Hollister recorded ; but these skulls were for the most part taken from lions which had been born and reared to maturity in captivity and had thus been subjected all their lives to conditions adverse to the formation of good bone and to the development of the muscles of the head, the continued use of which by the wild animal affects considerably the shape of the skull.[1]

What has been proved to be true of some lions is probably true of all. Hence it follows that the colour of a lion that has been a few years in captivity will be darker than that of a wild one from the same locality and that if he is mature or old he will have a more luxuriant, and, in some cases at least, a darker, mane, and also a differently shaped head. These facts have an important bearing on the classification of lions because several races of African lions have been named on the evidence of captive specimens, and I shall have to revert to the changes above pointed out in considering the characters and nomenclature of the lions dealt with in this paper.

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[1] Hollister's opinion, which obviously does not explain all the variations even in the skulls he examined was later challenged by Mr. A. Brazier Howell who thought that the deviations from the normal exhibited by the skulls of menagerie-reared lions were 'hardly influenced by the partial suppression of muscular stimuli, but were due to absence from the diet of some vitamin prohibiting rickets' (*Jour. Mamm.* 6, pp. 163–68, 1925). In my opinion both factors are concerned in altering the shape of the skull.

The Persian Lion.

The Persian lion was first nominally and racially distinguished under the name *Felis leo persicus* in 1826 by J. N. von Meyer (*Dissert. inaug. anat.-med.* Vienna. *De genere Felium*, p. 6), who described it very briefly as being without the mane on the belly found in the Barbary lion and as paler than the Senegal lion. The discovery of this rare paper we owe to Hollister (*Proc. Biol. Soc. Wash.*, xxiii, p. 123, 1910), and further particulars regarding it to J. A. Allen (*Bull. Amer. Mus. Nat. Hist.*, 47, p. 222 (footnote), 1924). Von Meyer, however, cited no previous record of the animal and there is nothing to show the source of his information about it. He mentioned no special locality in Persia where it occurs.

In the following year Temminck (*Mon. Mamm.*, p. 86, 1827), published a very much fuller account, based upon a pair of specimens from Teheran he saw living at the time in the Exeter, Change in London. He called it 'Le Lion de Perse' and described it as remarkable for its very pale isabelline colour, with the mane composed of hairs of more varied tints than in lions from Barbary and Senegal, the great locks of black and dark brown hairs contrasting strongly with the pallid hue of the body, and added that there were no long hairs on the belly or legs. The male measured from 7 to 8 or more feet, including the tail which was 2 ft. 7 ins. or 2 ft. 9 ins. long. The vagueness of these dimensions is evidently due to guess-work owing to the impossibility of running a tape-measure over the living animal. The lion was evidently exceptionally small, if adult; but there is clearly no evidence that it was full-sized.

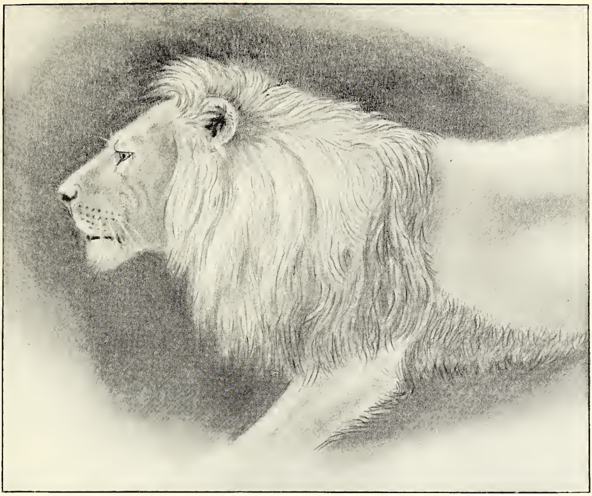
Temminck's description, above quoted, was the basis of the name *Felis leo persicus* proposed by Fischer (*Syn. Mamm.*, p. 197, 1829). Fischer, who was apparently ignorant of von Meyer's paper, described the animal as smaller than the Barbary and Senegal lions and very pale tawny (*pallidissime helvolus*), with a mane of moderate size, consisting of a mixture of black and dark grey hairs. This description appears to be nothing but a Latin version of Temminck's French description; and from Fischer's introduction of the word 'minor', it appears that he assumed the specimens Temminck saw were adult. There is no evidence that Fischer was personally acquainted with the Persian lion.

The only other name applied, so far as I am aware, to a lion from south-western Asia, was *asiaticus* given to one by Jardine (Jardine's *Nat. Library*, II, *Felinæ*, p. 121, pl. III, 1834). Jardine was unaware of, or ignored, the name *persicus;* and in his Synopsis, p. 266 of the same volume, he used the name *asiaticus* comprehensively for Asiatic lions, both Persian and Indian, having heard of Capt. Smee's description of what was unfortunately called the Maneless Lion of Gujerat. But the name *asiaticus*, on the available evidence, must be affixed to the Mesopotamian lion, because, to illustrate the characters of *asiaticus*, Jardine published a drawing by Lear of a full-grown male, then living in the Surrey Zoological Gardens which had been brought as one of a pair of cubs from Bussorah (Basra) and presented to King George IV and were exhibited at first in Exeter, Change before being moved to the Surrey menagerie. He also printed some notes on this animal supplied by Mr. Warwick of the Surrey Zoological Gardens, and his statement that Temminck 'calls this the Lion of Persia' shows that he regarded his animal and the ones described by Temminck as specifically or racially identical. My own opinion is that the animals described by Temminck and Jardine were probably the same individuals. Since Jardine's specimen was presented as a cub to King George IV, it must have been received before June 1830, the date of that King's death, and it may very well have been still living in 1833 when Jardine was writing his book. The apparent discrepancy between the alleged localities can be easily explained. Temminck stated that the examples he saw came from Teheran. When Warwick told Jardine that they came from Bussorah, he was probably citing the port of shipment. Again, the size that Temminck assigned to the lion he saw in 1827 forcibly suggests that it was immature. The animal figured by Lear in 1833 and named *asiaticus* by Jardine was fully adult and, judging from the figure, had a full mane and a fringe of hair all along the belly, thus differing from Temminck's description. But the differences may be reasonably attributed to age and a few more years of captivity fostering the growth of the mane. This suggestion that Temminck and Jardine described the same specimen under different names has an important bearing upon the views of Matschie regarding the lions of Persia, as recorded below.

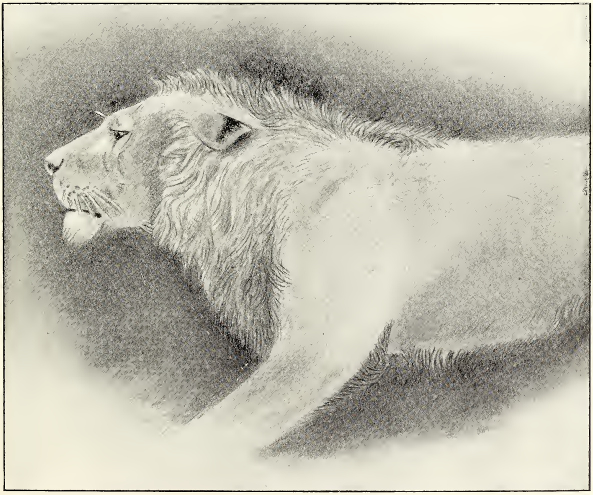
Lear's coloured figure represents a lion with a full mane covering the shoulders and tawny in hue round the face but turning blackish towards the shoulders and breast and blackish on the belly. The tail has a large tuft and the general hue is decidedly a paler yellower tawny than in a Barbary lion figured on Pl. II of the same volume.

Fitzinger, the next author to be mentioned in this connection, thought there were two kinds of lions in Persia (*Sitz. Akad. Wiss. Wien*, I, pp. 362–63, 1868). For the first he adopted the name *persicus* Fischer and quoted Temminck's description of the Teheran specimens; but knowing also Jardine's figure of the specimen alleged to have come from Bussorah, the specimen which was named *asiaticus*, and considering this animal to be specifically identical with the one Temminck described, he cited *asiaticus* as a synonym of *persicus* and modified Temminck's description by stating that the abdomen is maned and that the elbow carries a tuft. Although he remarked that no measurements were available, he described this Persian lion as the smallest known, thus apparently assuming that the examples Temminck saw and described were full-grown.

According to Fitzinger this lion was found in Afghanistan, Persia, Mesopotamia, Turcomania, Syria, Anatolia, Thrace Macedonia and northern Greece. But he can have known nothing of



The Persian Lion in the Surrey Gardens described by Jardine as *Leo asiaticus*. Adapted from Lear's drawing.



Persian Lion. Drawn from a flat skin in the British Museum.

European specimens; and I do not know on what authority the statement that it occurred in Afghanistan rests. He characterized it as ranging in colour from very pale tawny to ashy and as having a moderate mane of mixed dark grey and black hairs which extended along the belly.

To the second Persian species, or race, he admitted, he gave the name *guzeratensis*, an emendation of the name *goojeratensis* given by Smee to the Gujerat lion. Its distribution he stated was from India along the shores of the Persian Gulf to Mesopotamia and Arabia. It seems singular that he should have known so little of zoology as to suppose that two distinct species of lion occurred in South Persia and Mesopotamia. Nevertheless he distinguished this lion from the other Persian form by its darker tint ranging from tawny to pale reddish, its small uniformly coloured mane passing as a median crest over the withers but not along the belly. But this diagnosis is clearly taken direct from Smee's figure and description of specimens from Gujerat.

Matschie (*SB. Ges. Nat. Fr. Berlin*, 1900, p. 94) also admitted two races of Persian and Mesopotamian lions. For the first, named *persicus* Fischer, from Teheran, he adopted the descriptions previously published by Temminck and Fischer. His account of the animal as very small (*sehr klein*) shows that, like Fitzinger, he regarded the examples seen by Temminck as mature.

For the second race, inhabiting the Lower Euphrates, Babylon and Bussorah, he took the name *asiaticus* Jardine, thus differing from Fitzinger in thinking this lion was distinct from the Teheran lion. He distinguished *asiaticus* from *persicus* by being larger, darker coloured and carrying a heavier mane which extended along the belly. But it seems evident that Matschie's conception of this southern Mesopotamian race was derived mainly from Jardine's description and illustration of the Bussorah specimens exhibited in the Surrey Gardens in 1834 and from a statement (*Zool. Gart.*, iii, p. 97, 1862) that a Babylonian lion living at that date in the London Zoological Gardens had in proportion to its age a finer mane than one from Cape Colony in the same menagerie.

But Matschie's conclusion regarding the racial distinctness of these Persian lions, based on the data cited, clearly falls to the ground, if my opinion that Temminck and Jardine described the same individual lion is true, for that lion was the type specimen alike of *persicus* Fischer and of *asiaticus* Jardine. Moreover, the characters by which Matschie distinguished *asiaticus*, the greater size, the larger mane and the darker colour are precisely the characters one would expect to be acquired by an individual passing from youth to comparative old age under conditions of captivity. Assuming the lion to have been three or four years old when Temminck described it in 1827, it must have been nine or ten years old when Jardine named it in 1833. And since it is known to have been reared from a cub in the Exeter, Change and exhibited later in the Surrey Gardens, its luxuriant mane depicted by Lear as entirely covering the shoulders and extending as a long fringe down the breast and belly may confidently be assigned to its long period of captivity.

The same may probably be said of the mane of the Babylonian lion referred to by Matschie as mentioned in 1862. For this lion was one of a pair presented as a cub to the London Zoological Gardens in 1856. It was therefore fully adult in 1862.

Hence these two fine-maned specimens reared in captivity do not justify the conclusion that Mesopotamian lions produce big manes under natural conditions. They may do so at times, but I am not aware of any evidence in favour of that view. On the other hand, according to Olivier's testimony they may be maneless. This traveller stated (*Voyage dans l'Empire Othoman*, iv, p. 392, 1807) that in the menagerie of the Pasha of Baghdad he saw three maneless lions and two lionesses which had been captured five years previously at Bussorah. They were therefore mature. Apart from being maneless and smaller in size, they did not differ, he said, from African lions ; and by further inquiries he elicited the information that the lions of that district were without manes. Sir Percy Sykes also referred to maneless lions as occurring in his time between Bushire and Shiraz. But possibly both Olivier and Sykes used the word ' maneless ' in a comparative, not actual, sense as Smee did in 1833 when he described the Maneless Lion of Gujerat.

I am only acquainted with one record suggesting the possibility of the former existence of two races of lions in the Perso-Mesopotamian area. This was made by Layard (*Nineveh and Babylon*), who stated that he saw one, killed in Ram Hormuz, which was unusually large and of a very dark brown colour, in some parts of its body almost approaching black. He also described one killed in Khuzistan as ' unusually large with a short black mane.' But it is evident that both these specimens attracted his attention by their departure from the normal type of lions, with which he was well acquainted, inhabiting the areas he mentioned. His description of the example from Ram Hormuz indicates a lion much darker than any recorded before or since his time, so dark indeed as to make one think it might be regarded almost as a melanistic mutant, an interesting case, if so, because although tigers are sometimes black and leopards and jaguars not uncommonly, no black lion, so far as I am aware, has ever been seen.

Layard's record, however, need not further concern us since the lion is now no doubt extinct in that district and no zoologist would conclude on the evidence that this dark lion was racially distinct from the normally paler Persian type and name it accordingly.

The only Persian lion with which I am acquainted is a flat skin in the Natural History Museum received in 1847 and ticketed ' Persia. Warwick '. Since Warwick was associated with the Surrey Zoological Gardens, it is possible that the animal was exhibited in that institution. But there is no proof of this. At all events the skin was certainly not taken from the specimen, described by Jardine as *asiaticus*, if Lear's figure of that animal is to be trusted, unless it entirely changed the character of its mane in subsequent years, an eventuality which need not be entertained. Nor does the skin show either in its colour or in the luxuriance of its mane the effects that captivity has been known to bring about in some African lions.

Judging from its size, the skin, measuring, as recorded below, 9 feet 2 inches in length, was that of an adult, or nearly adult, animal, which, if a menagerie specimen, must presumably have been in captivity at least three years, since imported living lions are practically always taken as cubs when they can be handled without difficulty. Nevertheless the general colour is a pale tawny grey, paler or less richly tinted than most African lions owing to the black ticking of the hairs being less conspicuous or their pallid portion less ochreous or buff. The possibility of this paleness being due to exposure to light if the skin was used as a rug before reaching the Museum, where it has been kept in store, must be borne in mind. But the tint of the skin, as it stands, might, in my opinion, be truthfully described as ' very pale isabella ', the words Temminck applied to the Persian lion from Teheran.

The lower surface and the inside of the limbs are whitish but the white is nowhere sharply contrasted with the pigmented surfaces, the two blending imperceptibly. On the paws the hairs between the digits, on the claw-sheaths and round the digital pads below are brown.

The mane is not full and is nowhere black but all along the crest from the forehead to the withers and low down on the lower throat, in front of the base of the fore legs and on the chest between them it is greyish brown owing to the hairs being a mixture of black, grey and tawny. All round the face and on the sides of the neck back to the shoulders it is pale tawny, paler than the body owing to the absence of black specking on the haiss. Behind and above the ears the hairs are quite short and there is no mane on the sides of the forehead between the front end of the crest and the tuft in front of the ears. The shoulders are quite naked except along the middle line between the shoulder blades where the hairs are from 3 to 4 inches long. On the cheeks and sides of the neck they are about 3 inches, and reach about 4½ inches low down towards the base of the fore leg. For the sake of comparison I may add that the corresponding hairs in a full-maned Rhodesian lion, a picked specimen, are much longer, in some cases nearly twice as long. On the other hand there is a tolerably large, thick brown tuft on the elbow the hairs being 2 inches long. This tuft is larger than in the skins of most wild-killed African lions I have seen. There is no mane along the belly, only a few long pale hairs, which would be unnoticed in the living animal, far back towards the groin, but there is a very conspicuous fringe on the breast. The tail tuft is better developed than in the African skins above referred to.

Although neither the colour nor the length of the mane in this lion can be regarded as of systematic importance, the combination of a small short mane with a thick conspiucous elbow tuft and a long fringe on the breast does not occur in any African skins I have seen. In these, so far as my experience goes, the development of the elbow tuft corresponds with the development of the mane.

But the most noticeable difference between this skin and those of African lions known to me lies in the hair on the body which is quite perceptibly thicker and longer.

The Indian Lion.

The earliest account of an Indian lion with which I am acquainted was published by Griffith (*Vertebrated Animals. Carnivora*, p. 96, 1821) who wrote :—' A lion was lately exhibited at Calcutta which was brought from the interior, but which was not much larger than a mastiff, of a mouse-colour with scarcely any mane.' Mouse-colour is a little vague, but it probably meant reddish or brownish. No doubt the animal was an immature male, darker in tint than the adult.

The Indian lion was first nominally distinguished as a variety, *bengalensis*,[1] by Bennett (*The Tower Menagerie*, p. 1, 1829), who gave the name to an adult pair exhibited in the Tower of London. But since Bennett's account and illustrations have been apparently overlooked by all authors, except Blyth, it may be explained that these lions were captured as cubs early in 1823 by General Watson who succeeded in rearing them and getting them safely transported to England as a present to the King, who commanded them to be placed in the Tower.

Bennett described the illustration of the lion, drawn by William Harvey when the animal was in its prime at six years old, as a ' striking likeness.'

A point to be noticed about the sketch is the exceptional size of the mane which consisted of long, thick, hanging locks surrounding the face, covering the neck and the entire shoulders and extending all along the belly as a luxuriant fringe which in front invaded the flanks behind the lower part of the shoulder. It must have been the appearance of this lion that inspired Bennett to describe the Asiatic lion as carrying a mane ' in general fuller and more complete ' than that of the African ; and he wrote of its belly-fringe as a ' peculiar appendage.' On the annexed plate I give a sketch, adapted from Harvey's woodcut, to show the size of the mane in this lion.

Although this lion, which, according to Blyth (*Cat. Mamm. As. Soc.*, p. 53, 1863), was found in Hurriana, not in Bengal as Bennett thought, acquired its mane during its six years' life in captivity, it would be unwise to assume definitely that its growth was wholly the result of those conditions. It may have been an inherited character. Blanford, at all events, as recorded below, described two lions with very fine manes, one shot between Allahabad and Jubbulpoor and the other at Kota in Rajpootana ; and since in the case of the lions of Africa there is evidence that the finest maned specimens occurred at the Cape and in Algeria, the coldest districts they inhabit on that continent, it may be that lions of Hurriana, where the winter cold is tolerably severe, were naturally heavily maned.

Bennett also stated that the Asiatic lion ' seldom attains a size equal to that of the South African ' and that ' its colour is a more

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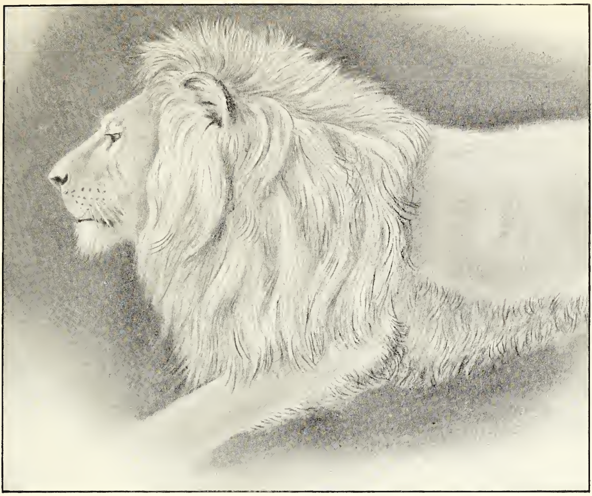
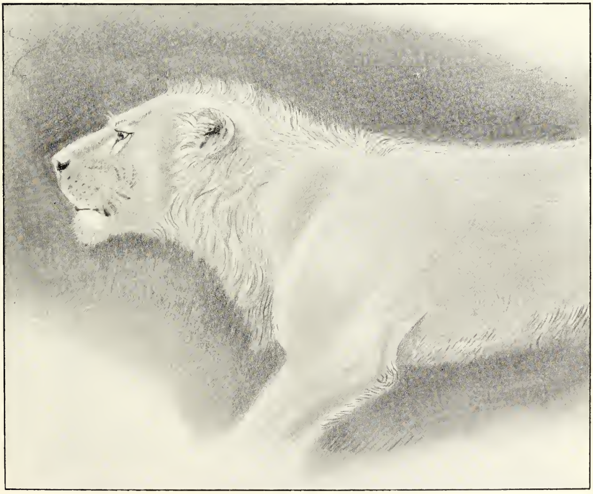
[1] This name is inadmissible for the Indian lion, having been previously applied by Kerr in 1792 to the well-known small leopard cat of India, *Felis bengalensis*.



Hurriana Lion in the Tower Menagerie described by Bennett as *Felis leo bengalensis*. Adapted from the original woodcut.



Gujerat Lion. Drawn from Capt. Smee's skin in the British Museum.

uniform and paler yellow throughout.' His use of the word 'throughout' suggests that the huge mane of the lion he described was for the most part at all events the same hue as the body, that the animal was in other words a 'tawny-maned', not a 'black-maned' lion. This agrees with the prevalent conception that Indian lions are mostly of the 'tawny-maned' type, although there is evidence of the existence in the country of partially 'black-maned' lions, as stated later on in this paper.

Four years after Bennett described and named the captive Bengal lion, Capt. F. Smee, without knowing Bennett's work, gave the name *goojratensis* to the lion of Gujerat (*Proc. Zool. Soc.*, Dec. 1833, p. 140), and followed this preliminary description with a fuller account illustrated by a coloured plate (*Trans. Zool. Soc.* I, p. 165, pl. 24, 1834). Unfortunately he adopted for his papers the trivial title 'The Maneless Lion of Gujerat ' But although he carefully explained that 'maneless' was only employed in a comparative sense to indicate, as he quite justifiably supposed on the evidence available at the time, that this lion could be distinguished from African lions by its smaller mane, the epithet was applied to the Gujerat lion over and over again by subsequent writers.

Smee's description of the animal was, nevertheless, quite good. The colour, he said, was fulvous (tawny) varying in intensity, being much paler in some specimens than others and palest in the oldest, and in dark specimens exhibiting a tinge of red and more black owing to the greater proportion of black hairs in the coat. The under surface, he added, was much paler than the upper, almost white. He also stated that the tail became gradually paler, passing into greyish white towards its extremity which carried an enormous black tuft, a very noticeable feature in Smee's illustration which was drawn by Lear.

The mane was tawny and poorly developed. It was short on the crown and nape, extended backwards as a low crest over the withers and was represented on the sides of the neck and throat by comparatively short hairs, the shoulders being entirely naked. Judging from the figure, the elbow-tuft was well developed and formed the upper end of a thick fringe of longish hair extending up the back of the fore leg. A very similar fringe extended along the belly and spread up the front of the thigh, the back of which was also fringed. The fringes on the belly and the front of the thigh were not, however, sharply differentiated from the flanks as in short-coated African lions that grow them, but blended imperceptibly with the hairs of the flanks which, it may be inferred, were tolerably long.

The largest lion obtained by Smee measured 8 ft. 9½ ins. in the flesh and was perhaps not quite full sized; but it gave the astonishing weight of 4½ cwts. (504 lbs.) without the viscera, which suggests a weight not far short of 550 lbs. with them. Selous once told me that the largest African lion he shot was 512 lbs.

The value of Smee's account of this lion lies in its being based upon a series of eleven specimens shot in the wild.

It is needless to repeat what the authors above quoted under the heading of the Persian lion wrote about the Indian lion, since they epitomized Smee's description without apparently being personally acquainted with the animal. Matschie, however, on evidence which is not forthcoming, supplemented Smee's account by stating that the Gujerat lion is very large (*sehr gross*), thus differentiating it from the Teheran lion (*persicus*) which he had previously recorded as very small (*sehr klein*). But, as has been explained, his conception of the Teheran lion was apparently derived from Temminck's description of a pair of young animals. Certainly neither Smee's account nor any record, so far as I am aware, published before or since supports the view that the Gujerat lion is, as Matschie also added, the largest of all the races of lion, except the Cape race.

One other name for the Indian lion must be recorded, namely, *indicus*, given to it by Blainville in 1843 when he inscribed under the figure of the skull of an Indian lioness the title *Felis leo indicus* (*Osteogr. Mamm. Atlas. Felis.* Pl. VI).

Blanford in 1867 (*Journ. As. Soc. Bengal*, XXXVI, pp. 189–91) in a paper dealing mainly with records of the occurrence of lions in various parts of northern India, contributed some useful particulars about a couple of lions.

A male shot near the railway between Allahabad and Jubbulpoor had a luxuriant mane, with the longest hairs 11 inches in length and the colour sandy yellow, except along the crest and across the shoulders where it was blackish. The stretched skin measured: head and body 6 ft. 10 ins., tail 2 ft. 10 ins., total 9 ft. 8 ins. Blanford's guess that the animal in the flesh was a little under 9 ft. was probably approximately correct; but equally likely it was a little more.

Of another shot near Kota in Rajpootana, of which he saw a coloured drawing by a competent artist, he said, 'The mane was very fine and well developed, although the beast was killed in the hot weather', when the mane might be expected to be smaller than in the cold weather.

Unfortunately Blanford supplied no information about the general colour, or texture of the coat, or about the belly-fringe, elbow-tuft or tail-tuft. But the record of the length of the mane in the specimen first mentioned is of great interest because the mane of this animal was several inches longer than the mane of the finest wild-killed African lion in the British Museum.

In *The Mammals of British India*, pp. 56–58, 1888, Blanford, who was professedly not dealing with local races and took merely a superficial interest in them, added nothing to our knowledge of the characters of Indian as opposed to African lions. He does not even state whether the measurements he cited of a lion and lioness and the dimensions of the skull of a lion, were taken from Indian or African specimens. I am, however, certain that he was mistaken in saying that a lion measuring only 8 ft. 9½ ins. in total length was 3 ft. 6 ins. high. The standing height of such a lion would have been about 3 ft. at the most.

Of later writers who have added to our knowledge of the Gujerat, or, as he called it, the Gir lion, the late Col. Fenton is the chief. (*Journ., Bomb. Hist. Soc.* XIX, p. 10, 1909). Unfortunately he said nothing about the colour or consistency of the coat but wrote at some length upon the development and tint of the mane and upon the animal's size. After repudiating the epithet 'maneless', he proceeded to ascribe the smallness of its mane as compared with African lions to its living in thorny scrub, accepting without demur the hypothesis that the mane is small from combing. I have already dealt with this suggestion and need not repeat what I said to refute it. He then quotes evidence for the occurrence of what he calls 'black-maned' lions in the Gir forest; but admits they are extremely rare. It does not seem that he actually saw or shot one himself. Nor is it clear what he meant by 'black-maned' in the matter of intensification and extension of the pigment. But to illustrate a second paper he wrote on hunting the Gir lion (*Journ., Bomb. Nat. Hist. Soc.* XX, 1910), the editor of that journal inserted a photographic plate (facing p. 737) of a full-grown lion in captivity at Junagadh. This animal, so far as it is possible to judge, had a mane at least as full and black as the best-maned East African lions; and making all allowances for the probable effects of captivity upon the length of the mane and for the possible effect upon its pigmentation, this lion attests the potentiality for the development of a large, partially black mane in the Gir lion. It is noticeable, however, that the mane of this lion is not comparable in luxuriance to that of the Bengal specimen, described by Bennett, which was six years in captivity in London, and it has no fringe along the belly.

With regard to the size of the Gir lion, Col. Fenton maintains that it is probably as large, on the average, as African lions. The largest he shot was 9 ft. 5 ins. Two others, a little younger, were respectively 9 ft. 1 in. and 9 ft. Thus the smallest was a little longer than the largest obtained by Smee; but the largest was smaller than one obtained by Lord Harris which was 9 ft. 7 ins. A comparison of these dimensions with those of lions from East and South Africa mentioned in Rowland Ward's *Records* suggests considerable superiority in the average size of the African specimens, which range from 9 ft. 8 ins. to 10 ft. 7 ins., the average of 30 examples being 10 ft. But, as Col. Fenton remarked, these examples were probably specially selected for measurement on account of their supposedly large size. At all events, out of a large number of adult males shot in British East Africa and the Eastern Belgian Congo for the American Museums and measured in the flesh by trained collectors the average length is only a little over 9 ft. Col. Fenton's contention, therefore, that the Gir lion is on the average as large as African lions seems well founded.

The only specimens of the Gujerat lion in the British Museum[1] are the tanned skin of a subadult male shot by Capt. Smee, the skin and skull of an adult female that was reared and exhibited in the Zoological Gardens, and the dried skin of a half-grown lioness. But thanks to the kind offices of Mr. Wilfred Osgood the authorities of the Field Museum of Natural History, Chicago, have most generously sent to me on loan the perfect skin and skull of a nearly adult male which was shot by Col. Faunthorpe. I am also greatly indebted to the Natural History Society of Bombay for sending to me for examination the skins of two specimens from the Gir Forest.

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[1] Seeing that there is not a single complete wild-killed example of this lion in the national collection it is galling to know that an English sportsman, Col. Faunthorpe, was permitted last year to shoot a couple of lions and a lioness in the Gir Forest for the American Museum of Natural History, New York. An account of this trip was written by Mr. A. S. Vernay, who accompanied Col. Faunthorpe, and published with photographs in *Journ., Amer. Mus. Nat. Hist.* Jan., 1930, pp. 81–89, and in *Country Life*, March 8, 1930. Mr. Vernay

The characters of these skins are as follows :—

(1) Capt. Smee's specimen. The coat is thick and long, a little longer than in the Persian skin above described, and lacks the sleekness and smoothness of the coat of most African lions, being long enough to be brushed in any direction.

Since this skin was for several years exhibited in the public gallery as a mounted specimen it is probably a little faded. Nevertheless it is a rich dark tint describable as rich ochraceous tawny, richer and darker than the Persian lion, with the black ticking of the hairs more in evidence. The colour of the flanks gradually blends with the buffy or cream white hue of the under side, and the same may be said of the outer and inner surfaces of the limbs; the toes are whitish with black and white hairs between them and black hairs on the claw-sheaths and round the pads ; up the back of the fore leg the hair gradually increases in length to expand into the elbow-tuft the hairs of which are about 2¼ ins. long ; a slightly darkened mat extends up to the hock on the hind leg. The tail becomes grey towards the end and the hairs beneath towards the tip are long, becoming longer where they pass into the black tuft, the greater part of which is missing.

The mane is small and scanty, much smaller than in the Persian specimen, being restricted to the nape, the fore part of the sides of the neck, the cheeks and throat. It is mostly tawny but brownish grey along the crest on the nape and low down in front of the base of the fore leg. On the withers the crest gradually blends with the adjacent hairs of the spine and on the head it is disconnected from the tuft in front of the ears and the hairs round the ears are short. The crest on the withers is about 2 inches long, on the nape nearly 3 inches, on the forehead in front 1½ inches, and low down on the cheek and throat the hairs are from 3½ to 4 inches.

On the posterior half of the belly on each side some longer hairs, nearly 3 ins. long, constitute an incipient belly-fringe everywhere blending with the longish hairs adjacent to it.

The measurements of the skin are : head and body 5 ft. 11 ins., tail (imperfect) 2 ft. 7 ins., total, allowing for the loss of 1 in. from the tail, 8 ft. 7 ins. Since the skin was stuffed and subsequently tanned it may be stretched. In any case it cannot be assumed to have been taken from the largest of Smee's specimens, presumably

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mentions the shooting of only two specimens, an old lion and a lioness. But Col. Faunthorpe secured a third, the subadult male described in this paper which belongs to the Chicago Museum and was kindly lent to me.

the one he figured, which measured in the flesh 8 ft. 9 ins. It is nevertheless a co-type of *Felis leo goojratensis*.

When the specimen was unstuffed it was found to contain a tiger's skull. Smee had two skulls but their whereabouts is unknown.

(2) Col. Faunthorpe's specimen in the Chicago Museum. This skin differs considerably from Capt. Smee's both in the texture of its coat and in colour. The coat is a trifle shorter but is smoother and obviously not so thick and loose. The body colour is much lighter everywhere, the pelage instead of consisting of rich ochraceous buff hairs with black tips is a mixture of clear whitish grey and pale isabelline hairs with black ticking, the general result being a buffish grey lion, silvery grey in certain lights, darker with a brownish tinge in others; the head, cheeks, outer sides of the limbs and the tail are also everywhere paler and greyer, although the hairs round the pads and on the toes are jet black. Also the chin, throat, inside of the fore leg and of the hind leg below the hock are cleaner white and the belly is whiter and less buff. When the two skins are placed side by side, Col. Faunthorpe's looks grey and Capt. Smee's brown.

There is very little to choose between them in mane-growth; but in Col. Faunthorpe's skin the mane is on the whole paler, being very much the tint of the body except on the cheeks where it is a richer golden buff with silky white reflections. The small elbow-tuft is a mixture of dusky grey and white hairs about 2½ ins. long. The tail-tuft is black, thick, with hairs about 2½ ins. long.

The skin measures: head and body 6 ft. 2 ins., tail 2 ft. 9 ins., total 8 ft. 11 ins. It is thus a little larger than Capt. Smee's. It may be stretched to a slight extent but not much, I think, since it was very skilfully stripped for mounting and was obviously never pegged out. But the skull shows clearly that the animal was not quite full-sized.

Although judging from their size, there is no great discrepancy between these two lions in the matter of age, the differences between them in the colour and texture of the pelage may be attributable to that factor. Or it may be a question of season. Col. Faunthorpe, as stated by Mr. Vernay, shot his lions in February 1929. But no date can be assigned to Smee's specimen.

(3) Of the two skins received from Bombay one is that of an adult or nearly adult male presented to the Natural History Society by the Maharajah Kumar Sahib of Kotah. It is unfortunately undated because the coat differs from that of the two skins already described in being short, rather coarse and lustreless, apparently dead hair ready for shedding. The general tint of the upper side is pale, a sandy grey, much paler and greyer than Smee's skin, but more sandy and less silvery grey than Faunthorpe's. It differs from both, especially from Faunthorpe's, in the complete absence of white from the under side and inside of the limbs. These areas, including even the chin, are washed with pale buff blending everywhere with the tint of the upper side.

The mane is tolerably thick but not so long or so shaggy as in the other skins and differently coloured. Except on the median crest and along the posterior border where there is a slight mixture of black imparting a brownish tinge, it is everywhere a rich rather golden tawny, lacking the greyish tint of Smee's skin, and is more sharply defined by its richer colour from the paler tint of the body. The elbow-tuft is distinct but small and mostly pale ; there is no trace of the belly-fringe, and the tail-tuft in conformity with the general shortness of the coat is small as in most African lions, not large as in the longer coated skins collected by Smee and Faunthorpe.

This skin has been merely cured, not dressed and stretched, and is certainly dried and shrunken. It measures : head and body approximately 5 ft. 5 ins., tail 2 ft. 6 ins., total 7 ft. 11 ins. It is difficult to estimate the extent to which it is shrivelled but the animal would probably have been at least another 12 ins. in total length.

(4) The second specimen received from Bombay is the skin of a young male. The coat is long and a dark greyish tawny in hue, darker than the last, owing mainly to the conspicuousness of the black tips to the hairs, but it is not so dark or richly coloured as Smee's skin, there being much less ochraceous tawny in the hair. The chin and throat and most of the inner side of the fore leg are tinged with buff ; but the belly and inside of the hind leg are white. Spots are evident below, pale tan on the belly, brownish on the hind legs, paler and smaller but traceable to the paws on the fore leg. The mane is undeveloped but there is a conspicuous black crest on the nape formed by the confluence of the black tips of the convergent streams of hair. The elbow-tuft is small but traceable ; but most of the middle of the tail-tuft is missing. This skin measures : head and body 4 ft. 10 ins., tail 2 ft. 2 ins., total 7 ft.

I have described these four skins at some length because of the lack of detailed information about the variation in colour of the Indian lion.

The following points are interesting :—

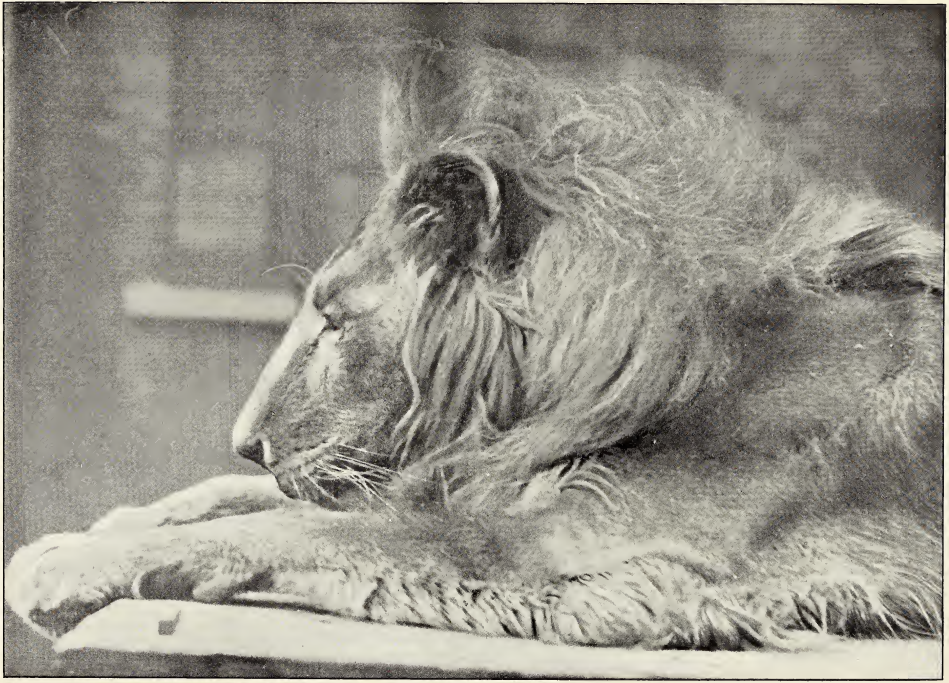
(1) The immature skin, although darker than two of the others, is not so dark or richly coloured as the third, namely, Capt. Smee's skin.

(2) The general shortness, scantiness and lifeless aspect of the hair of the skin that belonged to the Maharajah of Kotah, especially when compared with the thick, long, luxuriant coat of Capt. Smee's specimen, forcibly suggest considerable seasonal change in the colour and texture of the pelage.

(3) The Maharajah of Kotah's sandy grey skin is also interesting on account of the pale buff tint of the whole of the light parts.

(4) Precisely similar variations in the length of the coat and the colour of the upper and under sides, exhibited by these three skins, have been used by American zoologists as a pretext for dividing the lions of Central East Africa into four named local races or sub-species.

(5) The Persian skin, above described, is not exactly like any one of the three Gujerat skins, but does not differ more from them than they differ from each other. It is darker and more ochraceous tawny than the Maharajah of Kotah's skin, coming nearly midway between it and Smee's richly coloured skin.



Gujerat Lion presented to the Zoological Society, London, by H. H. the Maharajah Sahib of Nawanagar.

The only other Gujerat lion I have seen is one presented to the Zoological Society in 1921 by H. H. the Maharajah Jam Saheb of Nawanagar. It was a full grown animal, rather pale tawny or sandy in tint ; but it had been in captivity for many years and had developed a good shaggy mane, as shown in the photograph of its head here published (Pl. III). A noticeable feature about this lion is the length and thickness of the hair along the back of the fore leg up to the elbow-tuft, and the fringe on the fore part of the chest below ; also the extension of the mane as a very distinct fringe behind the shoulder, this being a common feature in lions kept many years in captivity. The coat is generally longish.

(6) The tanned skin, with skull, of the adult lioness from Gujerat which died in the Zoological Gardens on February 21, 1857[1] and was presented by the Society in that year, is very handsome, with an exceptionally long and thick coat, longer everywhere, allowing for the absence of mane, than in Capt. Smee's lion, being as much as 3 ins. on the breast, belly and elbows. The tail-tuft also is large, the hairs measuring up to 3½ ins. in length and considerably exceeding those of wild-killed African lions. The colour is a rich almost ruddy tawny, a little richer and darker in tint and more heavily speckled with black than Capt. Smee's lion above described. It agrees very well with Smee's description of the darker Gujerat specimens which were said to be reddish in hue. The light parts also are rather better coloured than in Smee's lion. It may be that the dark hue and long coat of this lioness are due to several years of captive life. But if Smee's specimen is a little faded from exposure as a mounted specimen, there was not much difference between the two. The skin measures : head and body 5 ft. 4 ins., tail 2 ft. 8 ins., total 8 ft.

(7) The skin of a young lion from Junagadh, Kathiawar, which was exhibited at the Colonial Exhibition of 1886 and was presented by H. H. the Nawab Sahib. The colour of this skin is quite unusual. It is a dark rufous-brown tawny all over, even on the under side and the inner surfaces of the limbs. There are spots on the legs, stronger on the hind than on the front. The animal was probably about a year old since the flat skin measures; head and body 3 ft. 8 ins., tail 1 ft. 8½ ins., total 5 ft. 4½ ins.

There can, I think, be no doubt that the dark reddish tint of this skin, pervading as it does the usually whitish or buffy white lower parts and also the inner hairless surface of the hide, is due to staining from some preparation with which the skin was dressed.

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[1] Although this skin is merely labelled 'Asiatic lion', there is, in my opinion, no doubt that it belonged to the female of a pair from Gujerat presented to the Zoological Society by the Rajah of Jahnuggar through Sir Erskine Perry and Capt. Jacob in January 1854. According to the Society's records there were in the later fifties of the last century two pairs of Asiatic lions in Regent's Park, namely, the pair above referred to and a pair from Mesopotamia presented in 1856. This pair was entered in the books as 'young' ; and since the skin and skull under notice are those of an animal fully mature early in 1857, she cannot have been the female of the Mesopotamian pair. Since, moreover, the Museum of the Zoological Society was disposed of in 1854, this lioness clearly did not form part of the old collection.

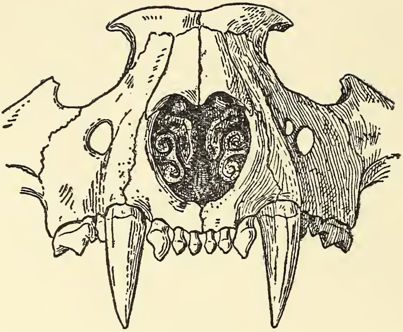
The following table shows the lengths of some Indian lions, taken in the flesh or derived from skins :—

Locality and Sex	Total length	Head and Body	Tail	Remarks
	ft. in.	ft. in.	ft. in.	
Gir Forest ♂ ...	10 2	7 6	2 8	Stripped skin (Lord Lamington).
Allahabad ♂ ...	9 8	6 10	2 10	,, ,, (Estimated length about 9 ft.).
Gir Forest ♂ ...	9 7	...	...	In the flesh (Lord Harris).
,, ,, ♂ ...	9 5	6 6	2 11	,, ,, (Col. Fenton).
,, ,, ♂ ...	9 3	6 6	2 7	,, ,, (Count F. Scheibler, ex Rowland Ward).
,, ,, ♂ ...	9 1	...	...	,, ,, (Col. Fenton.)
,, ,, ♂ ...	9 1	...	...	,, ,, (A. S. Vernay. An old lion).
,, ,, ♂ ...	9 0	...	...	,, ,, (Col. Fenton).
,, ,, ♂ ...	8 11	6 2	2 9	Dressed. (Col. Faunthorpe in Chicago Museum).
Ahmedabad ♂ ...	8 9½	...	...	In the flesh (Capt. Smee's largest).
,, ♂ ...	8 6	5 11	2 7	Dressed. Tail imperfect (Capt. Smee in Brit. Mus.)
Gujerat ♀ ...	8 0	5 4	2 8	,, (Zool. Soc. in Brit. Mus.).

It may be added that Col. Fenton ascertained that the dimensions of Lord Lamington's specimen were taken from the stripped skin. He therefore rejected them as exaggerated. According to Blanford the skin from Allahabad was also stretched. Eliminating the dressed or stripped skins and Capt. Smee's largest specimen, which was very doubtfully mature, and taking the specimens from the Gir Forest which were measured in the flesh, we find that the average total length of these six is slightly under 9 ft. 3 ins., which is about the same as the average of East African lions.

The Skulls of Indian Lions.

In a note on the skulls of lions and tigers contributed to Capt. Smee's paper on the Gujerat lion, Prof. Owen described in the skulls of two Indian lions, preserved in the Museum of the Royal College of Surgeons, a peculiarity he failed to find in the skulls of African lions. This was the duplication of the infra-orbital foramen, at the anterior root of the zygomatic arch, by a bridge of bone dividing it into an upper smaller and a lower larger portion.



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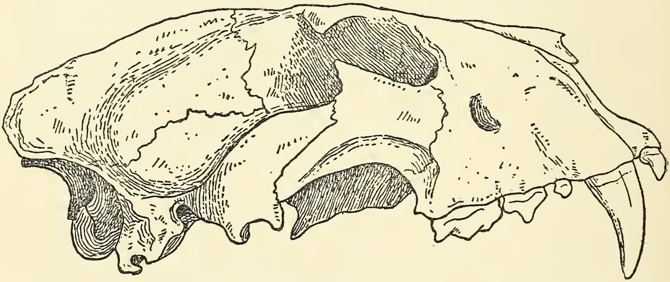

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FIG. A (1) Facial portion of skull of lioness from Amreli showing duplication of the infraorbital orifice on the left side.

FIG. A (2) Lateral view of skull of adult male lion from Amreli.

In one of the skulls from 'Assund in N.W. Hindustan', presented by Col. Finch in 1830, this peculiarity was present only on the left side, the foramen on the right side being large, reniform and normally entire. In the other specimen from North Gujerat, received in 1822, the orifice was more widely bridged on both sides but not quite symmetrically, the bridge on the right side being wider than on the left and showing a third small hole. Capt. Smee recorded similar division of the foramen in the two skulls he possessed. Great, therefore, was my interest to find this foramen divided on both sides in Col. Faunthorpe's lion skull belonging to the Chicago Museum. In this skull the arrangement is very nearly symmetrical, the bridges being narrower than in the skull from North Gujerat, so that the lower orifices are larger, thus resembling the condition seen in the foramen of the left side in the skull from Assund. (Plate IV, Figs. A 1 & 2)

Nevertheless in three skulls that have recently come into my hands, the modification is present on one side only in two of them; on the right side in a young lion and on the left side in a young lioness. It is absent in an adult lion. It is also absent in the skull of the lioness received from the Zoological Society. It cannot, therefore, be regarded as an absolute distinction between Indian and African lions, although, on the available evidence, it occurs in most of the former, but never occurs in the latter. It presumably originated as a fortuitous variation. No use can be claimed for it, yet from the records given above we know that it has been inherited for over a century and how much longer it is impossible to say.

On inspecting the two skulls, referred to as lions by Owen, in the Museum of the College of Surgeons where they were kindly submitted to me by Mr. R. H. Burne, F.R.S., I was disappointed to find they are skulls of lionesses, although one of them is entered in Flower's Catalogue of the collection as a lion's. Both, however, are adult, although the one from Assund is considerably the older of the two. (Plate V, Figs. B 1 & 2)

The three skulls above referred to as recently received were kindly presented to the national collection by the Maharaja of Bhavnagar when he learnt from Lt.-Col. A. H. E. Mosse, I.A., on information received from me, that the British Museum possessed no skull of a wild-killed Indian lion. The animals themselves, an old male and sub-adult male and female, were shot some twenty years ago, by the late Maharaja in the Amreli District of Kathiawar on the eastern border of the Gir Forest. The skins were made into rugs with the skulls mounted in them and preserved in the Maharajah's Palace; but the skins proved to be worn and useless and only the skulls were worth preserving. I am greatly indebted to Col. Mosse for securing these valuable specimens for the Natural History Museum and for the opportunity thus afforded of recording their characters in this paper. The skull of the adult male is perfect apart from the loss of a few teeth; but the loss of the occipital bone in the others prevents me recording their lengths and observing the shape of the auditory bullæ.

The following table gives the principal dimensions of the skulls

I have been able to measure.[1] To these have been added one or two measurements of a few skulls elsewhere recorded. The cranial dimensions are expressed in English inches, the teeth in millimetres.

Locality.and Sex	Total lg.	Cond. var lg.	Zygom. width	Mastoid width	Waist	Int. orb. width	Max. width	Nasals	Upper carnal	Lower carnal	Upper canine
Gir Forest ♂ ...	13·4	...	8·6	...	...	...	...	...	...	...	...
,, ,, ♂ ...	13 2	...	9·0	...	...	...	...	...	...	...	...
,, ,, ♂ ...	13	12	8·5	5·2	2·1	2 7	3·6	4·1 × 2·3	36	24	27
Amreli Dist. ♂	13·4	12·1	9·1	5·2	2·1	2·9	3·9	4·1 × 2 5	37	25	27
,, ,, ♂	...	...	7·9	...	2	2·4	3·4	3·8 × 2·1	38	27	27
,, ,, ♀	...	...	7·2	...	1·8	2·1	3·1	3·2 × 1·9	35	23	21
Assund ♀ ...	11·5	10·5	7·7	4·5	2·1	2·4 +	3·4	3·3 × 2·2	36	24	...
N. Gujerat ♀ ...	...	10·7	7·5	4·5	2	2·4	3·2	3·6 × 2·1	36	25	21
,, ♀ ...	11·7	10·7	8·2	4·5	2	2·4	3·4	3·7 × 2·2	34	25	21
India ? ♀ ...	11·2	10·3	...	...	...	...	...	...	34	24	20

The first on the list is the skull of the largest recorded by Col. Fenton. Although supposed to be adult it is rather narrow for a mature specimen. The second is Lord Harris's specimen recorded by Rowland Ward. The third is Col. Faunthorpe's Chicago Museum skull which, as shown by its open sutures is not quite full sized. The three specimens from the Amreli District are those that belonged to the Maharajah of Bhavnagar. The complete skull is that of a fully adult but not very old male. It is remarkable for the great height of the sagittal crest which rises in front from two strong curved upstanding ridges running backwards and inwards from the post-orbital processes. This crest is higher than that of any African lion skull I have seen. The immature and imperfect male and female skulls from this district call for no special

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[1] The dimensions are taken as follows :—Total length from the edge of the premaxilla above the incisors to the tip of the occipital crest. Condylo-basal length from the same point in front to the posterior edge of the occipital condyles. Zygomatic width across the cheek-bones. Mastoid width across the occipital bone outside the auditory bullæ. Waist across the post orbital constriction. Interorbital width across the forehead between the eyes—Maxillary width across the jaw just above the socket of the upper canines. Nasals from the middle line behind to the extreme tip of the bone in front. Upper and lower carnassial teeth their extreme length. Upper canine its length from back to front close to the socket.

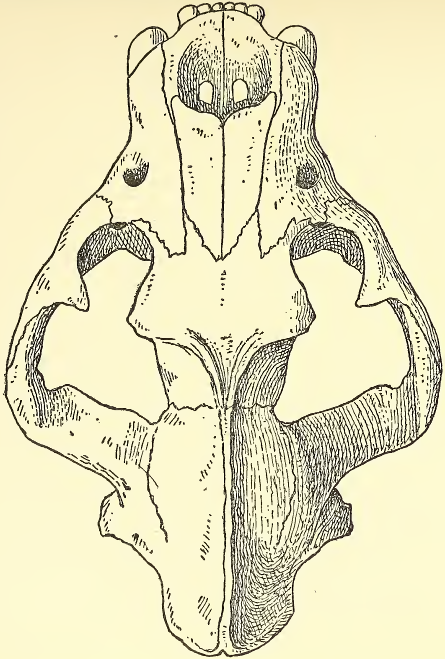

FIG. B (1) Dorsal view of skull of adult male lion from Amreli.

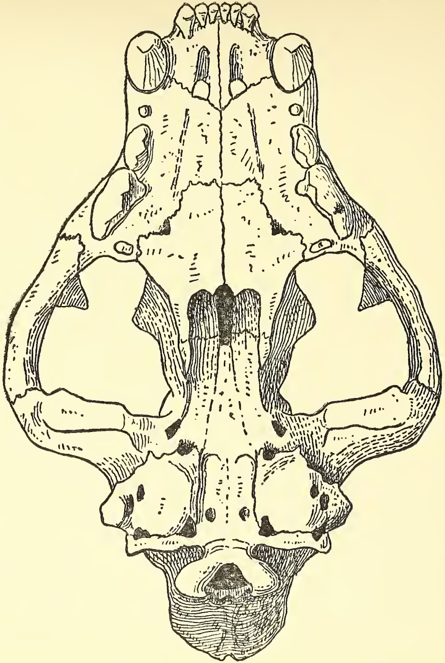

FIG. B (2) Ventral view of skull of adult male lion from Amreli.

comment except regarding the size of the carnassial teeth in the young male which are noticeably larger than in Col. Faunthorpe's specimen.

Of the lionesses those from Assund and N. Gujerat are the two in the College of Surgeons' Museum. The one labelled Gujerat is the skull of the specimen reared in the Zoological Gardens, a circumstance which explains its greater width across the zygomata. It also has the ascending process of the mandible considerably lower than in the wild-shot specimens. The dimensions of the last on the list marked ' India ' are taken from Blainville's illustration of a specimen he regarded as a lion's skull and figured half natural size. From the shape of this skull I am tolerably confident it was taken from an adult lioness reared in a menagerie.

Although the data supplied by this table of measurements suggest that the skulls of Indian lions are on the average a little smaller than those of any race of African lions, they are at present insufficient to justify a definite conclusion on that point. But apart from the duplication of the infra-orbital orifice which is not an absolute distinction, there is one character in which they differ from African lion skulls. The auditory bullæ are noticeably less inflated. These bullæ vary a good deal, it is true, in that respect in African lions, but I have seen no skulls from that continent in which they are so low as they are in the two lion and three lioness' skulls, in which these structures are preserved, recorded in this table.

Summary and Conclusion.

The foregoing account reveals considerable difference of opinion, based in no case apparently upon reliable data, regarding the number of races inhabiting Asia. Jardine, when he introduced the name *asiaticus*, thought there was one occurring both in Persia and India. Wagner and Fitzinger admitted two, a Persian race, *persicus*, and an Indian race, *goojratensis*, although Fitzinger claimed that the latter extended from India to Mesopotamia along the shores of the Persian Gulf. Matschie, as recently as 1900, considered that there were three, a northern Persian race, *persicus*, a southern Persian race, *asiaticus*, and an Indian race, *goojratensis*. But his view with regard to the Persian lions was founded upon Temminck's description of a lion from Teheran exhibited in London and upon Jardine's description of one exported from Bussorah, also exhibited in London. It is very likely, however, that the same lion at different ages was the subject of both these independent descriptions. However that may be, the lions, if there were two, were captive specimens, and untrustworthy in the characters Matschie relied on for distinguishing them from each other and from *goojratensis*.

I think it may be confidently claimed that there is, or rather was, only one kind of lion in Persia; and since the only skin I have seen from that country shows, in my opinion, no characters justifying its nominal distinction from Indian specimens, I am compelled on the data available to regard the lions of these two districts of Asia as racially identical and to cite them under the same name. It is a pity that *asiaticus* is not available for this purpose and that *persicus*, proposed by Meyer, in 1826, has to be adopted[1] as its title.

I have given below at some length my reasons for regarding the Asiatic lion as racially or sub-specifically distinguishable from the numbers of West and East African lions which have been established and with which I am acquainted. But the races represented by the extinct Cape lion and the nearly extinct Barbary lion, I only know from published accounts. But, so far as I can judge, these two lions fell into line with other African lions in the characters employed for distinguishing the Asiatic form.

Taking first the references relating to Persian lions and second those relating to Indian lions, the name and synonymy of this asiatic race are as follows :—

PANTHERA [2] LEO PERSICA, Meyer.

Felis leo persicus, Meyer, Diss. inaug. de genere Felium. Vienna. p. 6, 1826 (source of name unstated).

Felis leo var. c. ' Lion de Perse ', Temminck, Mon. Mamm. p. 86, 1827.

Felis leo persicus, Fischer, Syn. Mamm. p. 197, 1829 (Based on Temminck's description of a pair from Teheran); Wagner in Schreb. Säug. Suppl, ii, p. 463, 1841 ; Fitzinger, SB. Akad. Wiss. Wien, I, p. 362, 1841 (quoted as *Leo persicus*).

Leo asiaticus, Jardine, Nat. Library : Felinæ, pp. 121 and 266, 1834 (Based on specimen exported from Bussorah, probably the same that Temminck described).

Felis leo asiaticus and *persicus*, Matschie, SB. Ges. nat. Fr. Berlin, p. 94, 1900.

Felis leo bengalensis, Bennett, The Tower Menagerie, p. 1, with woodcut, 1829 (preoccupied name).

Felis leo goojratensis, Smee, Proc. Zool. Soc. p. 140, 1833 and Tr. Zool. Soc., I, p. 165, pl. 24, 1834. This name altered to *guzeratensis* by Wagner (*op. cit.* p. 461), by Fitzinger (*op. cit.* p. 365) and other authors ; to *gougeratensis* by Ham. Smith in Jardine's Nat. Library XV, p. 178, pl. XI, 1842 ; to *gozeratensis* by Brehm, Ergeb. Reise nach Habesch, p. 58, 1863 ; to *goojrattensis* by Matschie (*loc. cit.*).

Felis leo indicus, Blainville, Ostéogr. Mamm. Atlas : Felis. Pl. VI, 1843.

Type Locality of *persicus* Meyer unknown. Type not in existence.
,, ,, ,, *goojratensis*, Ahmedabad. Co-type in Brit. Mus.

Distribution : Formerly Central and Southern Persia and Meso-

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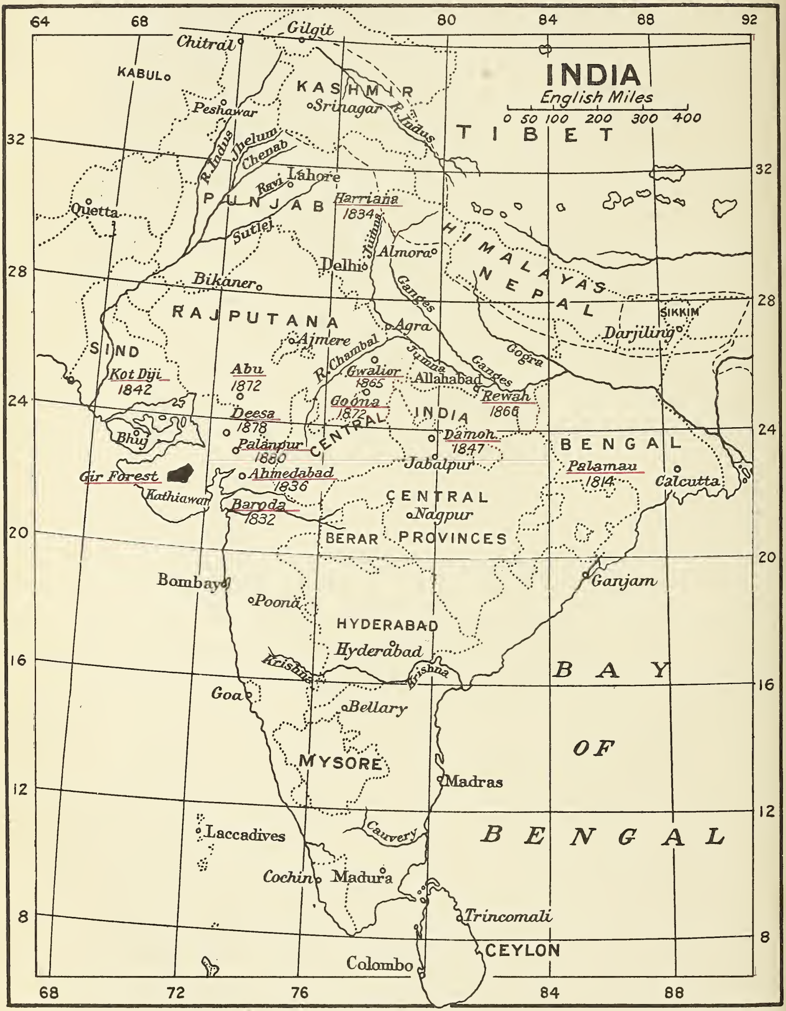
[1] This name *persicus* antedates all the names given to races of African lions, except *barbaricus* assigned by the same author to the Barbary lion. Yet several racial names have been given to African lions by authors who have made no attempt to justify that course by mentioning any character by which they can be separated from the lion named *persicus*. The difference in distribution has been held to be a sufficient reason for introducing the new names, many of which have merely a geographical significance.

[2] I need not here repeat the reasons I gave in my paper on 'Tigers' (*Journ. Bombay Nat. Soc.*, vol. xxxiii, p. 506) for referring the lion, tiger and panther to the genus *Panthera* instead of *Felis* nor for rejecting the generic name *Leo* for the lion.

MAP SHOWING THE PAST AND PRESENT DISTRIBUTION OF THE LION IN INDIA.


INDIA
English Miles
0 50 100 200 300 400
64
68
80
84
88
92
32
28
24
20
16
12
8
72
76
Chitral
Gilgit
KABUL
Peshawar
KASHMIR
Srinagar
R. Indus
TIBET
R. Indus
Jhelum
Chenab
Ravi
Lahore
PUNJAB
Quetta
Harriana 1834
Sutlej
Jumna
Almora
HIMALAYAS
NEPAL
Delhi
Bikaner
Ganges
RAJPUTANA
Agra
SIKKIM
Darjiling
Ajmere
R. Chambal
Jumna
Ganges
Gogra
SIND
Kot Diji 1842
Abu 1872
Gwalior 1865
Allahabad
Rewah 1866
Goona 1872
Deesa 1878
INDIA
CENTRAL
Bhuj
Palanpur 1880
Damoh 1847
BENGAL
Jabalpur
Palamau 1814
Calcutta
Gir Forest
Ahmedabad 1836
Kathiawar
Baroda 1832
CENTRAL
Nagpur
BERAR
PROVINCES
Bombay
Ganjam
Poona
HYDERABAD
Hyderabad
Krishna
Krishna
BAY
Goa
Bellary
OF
MYSORE
Madras
Laccadives
Cauvery
BENGAL
Cochin
Madura
Trincomali
CEYLON
Colombo

John Bale, Sons & Danielsson, Ltd London.

The dates indicate approximately the years when the lion became extinct at the various localities which are underlined with red.

potamia and the whole of Northern India as far north as Patiala,[1] eastward to Western Bengal but not passing south of the Tapti River. Now apparently restricted in S. W. Asia to the Gir Forest, Kathiawar.[2]

For the opportunity to publish the accompanying map showing the former range of the lion in India and the dates, so far as they can be ascertained, when it is supposed to have been exterminated in various districts, I am indebted to Mr. W. S. Millard and to Sir Reginald Spence. It was prepared for the Museum of the Bombay Natural History Society by Mr. N. B. Kinnear when he wrote his paper, above quoted, on the distribution of the lion in Asia.

Distinguishing characters of the Asiatic lion.—When the Persian skin and the two Gujerat skins,[3] collected by Smee and Faunthorpe respectively, are compared with a number of lions' skins in the British Museum from West, East and South Africa, one or two curious differences are revealed.

The Elbow-tuft.—In the Persian skin, which, judging from its length and mane-growth, is that of a fully adult animal, the elbow-tuft is not only actually very extensive but is especially large when compared with the size of the mane. It forms a distinct mat about 9 ins. in vertical length, blending imperceptibly below with the longish hair on the back of the foreleg.

In African lions with the mane of about the same size the tuft is either absent or exceedingly small. Even in a lion, shot by Selous on the Hartley Hills, Mashonaland, which carries a far more luxuriant mane than the Persian skin, the elbow-tuft is much less extensive both in width and length, although the hairs composing it are longer. It is emphatically a 'tuft' and not a 'mat'. This remark applies to other fine-maned African lions.

In Smee's and Faunthorpe's Gujerat specimens, which are not quite mature and have more scanty manes, the elbow-tufts are well developed and tuft-like, as well developed approximately as in good-maned African lions. No African lions' skins that I have seen with manes as poorly developed, whether adult or immature, have a trace of the elbow-tuft. The tuft, however, in Faunthorpe's specimen is more isolated. In Smee's specimen, which is much thicker-coated, it is more confluent below with the long hair on the back of the leg as in the Persian skin and as shown in Smee's coloured figure of his typical example of *goojratensis*, in Jardine's figure of the Bussorah specimen in Exeter, Change and in the photograph of the Gujerat specimen here reproduced (Pl. 3).

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[1] The killing of a lion by an elephant close to Patiala was recorded by Capt. Mundy in *Pen and Pencil Sketches*.

[2] After the extermination of the native lion everywhere in India, except in Kathiawar, some East African lions were imported into the country and released in Gwalior about 30 or 40 years ago; but they became such a pest by killing the cattle and their herdsmen that they were all exterminated a few years afterwards. (A. S. Vernay.) They did not spread to Gujerat. Hence the Gir Forest lions are a pure stock.

[3] In this summary I have not taken into consideration the skin obtained by the Maharajah Kumar of Kotah because the pelage is obviously old and dead with the moult imminent, if not already begun.

The Belly-fringe.—In the Persian skin there is a very distinct thickish median fringe or crest about 6 ins. long and composed of hair 4 ins. long on the chest behind the armpits (axillæ) and quite separated from the mane on the front of the breast below the throat. In the heavily-maned Hartley Hill lion, above referred to, and in one from the Pungwe River, this crest is merely represented by a few longish scattered hairs. In no other African lion skin that I have seen is there a trace of it. It is not, however, developed in the two Gujerat skins, possibly because they were younger animals than the Persian.

Neither in the Persian skin nor in Smee's Gujerat skin is the rest of the belly-fringe sharply differentiated from the longish hairs of the lower part of the flanks. In both, however, it is represented by a fringe of longish hairs, the fringe being more noticeable and more extensive from front to back in the Gujerat skin. In no African lion's skin does the same condition prevail. In only one of them, namely the skin of a full-grown, fairly well maned lion, shot by Selous between the Sungwe and Pungwe Rivers in Portuguese S. E. Africa, is there a trace of the belly-fringe ; and in this it is a scanty isolated tuft of long hairs well developed only on one side of the body. As evidence that this type of belly-fringe, so far from being exceptional, is the rule, at all events in South African lions, I may quote the testimony of Selous who, when writing of lions with 'very full black manes', said :—'In such cases, in addition to the tufts of hair always found on the elbows and in the armpits of lions with fair-sized manes, there will probably be large tufts of hair on each flank just where the thighs join the belly'. (*Living Animals of the World*, p. 38, about 1908).

The Tail-tuft.—Jardine, quoting Warwick's observations on captive specimens, stated nearly a century ago that the tuft at the end of the tail is much longer in proportion in the Persian than in the African lion; and this feature is shown in Lear's figure of the lion exported from Bussorah which Jardine reproduced. In the Persian skin in the British Museum the tuft is noticeably more bushy than in most of the African lions' skins, though not much more so than in a few ; but Smee's figure of the Gujerat lion shows a remarkably large tuft, quite as large as the tuft in the skin of the lioness from Gujerat that was presented to the Museum by the Zoological Society. In Faunthorpe's Chicago skin the tuft is not so large ; but it would be considered a good tuft in an adult African lion, although the specimen in question is not quite mature.

The Coat.—The tail-tuft is not a secondary sexual character like the mane, elbow-tuft and belly-fringe, and its superior development in the Asiatic lion may be an accompaniment of the generally longer coat observable in this lion than in African lions. But in two African lionesses, collected by Sir Harry Johnston but otherwise unlocalized in the British Museum, the coat is long and full without corresponding enlargement of the tail-tuft. As regards the coat itself in adult African lions it is usually short and sleek ; but since longer coats are said to be found in lions at high altitudes in some districts and in the lions of the areas immediately to the south east of Victoria Nyanza, the most that can be said on this point is that the Asiatic lions appear to have on the average longer and thicker coats than African.

The Skull.—No information, so far as I am aware, is available regarding the skull of Persian lions; and I have seen only three skulls of wild-killed Indian lions. In addition to the bridging of the infra-orbital foramen above described, these skulls differ at all events from average skulls of African lions in the comparative flatness of the auditory bullæ. These bullæ however, are liable to a great deal of individual variation in African lions; and they are probably also equally variable in the Asiatic. But beyond question they are in almost all cases considerably more inflated in African skulls than in the Indian specimens I have seen.

In other characters upon which systematists have laid stress in distinguishing the named local races of lions, the Asiatic form exhibits or exhibited great variation. The general colour ranges from ochraceous tawny, almost reddish, to sandy or isabelline grey or even blackish (Layard), and the mane, although typically moderate or small, was sometimes very fine, sometimes undeveloped; its general tint being usually 'yellow', sometimes relieved by 'black'. Similar variation in the colour of the coat and in the colour and growth of the mane occurs in the lions of Kenya Colony, East Africa.

Briefly epitomizing what I have stated above in justification of the view that the Asiatic lion may be regarded as a local race, *Panthera leo persica*, I may say that it differs at all events on the average from the African races in the following features:—

The coat is longer and usually thicker; the tail-tuft is larger; the elbow-tuft and belly-fringe are comparatively well developed in association with a poorly developed mane; and, at all events in the skull of Indian specimens, the auditory bullæ are less inflated and the infra-orbital foramen is usually divided by a bony bridge.

SUPPLEMENTARY NOTE ON TWO LIONS SHOT BY H. H. THE MAHARAJAH JAM SAHEB OF NAWANAGAR IN KATHIAWAR

After this paper was set up in type, I had the good fortune, through the courtesy of H. H. The Maharajah Jam Sahib of Nawanagar and of Messrs. Rowland Ward, to examine the skins and skulls of two additional Indian lions recently shot by His Highness in Kathiawar. Both specimens are fully adult and of exceptional interest, although unfortunately, owing to the return of the skins kindly lent to me by the Field Museum, Chicago, and by the Bombay Natural History Society, I am unable to place the Jam Sahib's skins alongside them for actual comparison.

The two skins are much alike, the coat being short and smooth in both, approximately as in Faunthorpe's Chicago skin so far as I recollect and much shorter than in Smee's skin. In one the general colour of the body is decidedly grey, a pale olivaceous grey, the hairs being pallid buffish grey with black and brown tips, without any brightness; but low down on the flanks, the tint is a bright ochreous buff, sharply defined from the tint of the back, which passes into creamy buff on the belly. The foreleg is richer tinted and less speckled than the back on the outer side, rich buff in front turning to creamy white behind on the inner side; the elbow-tuft is well developed, consisting of black and grey hairs, 3½ inches long. The hind leg is ochreous buff internally and in front, greyish up to the hock behind and almost black above the hock. The long interdigital hairs on the fore and hind paws are black. The tail above is like the body in general hue but turns rapidly black towards the end and is cream-buff below; the tuft is moderately large, with hairs up to 2¾ inches long. The mane is well developed, long and thick, with a considerable amount of black in it, although pale tawny on the cheeks, throat and behind the ears; in front of the shoulder, especially low down, the black is very much in evidence; and along the crest some of the hairs are black throughout, although most of them are grey at the base with black tips, there being more black on the fore part of the nape than behind. The hairs on the crest and cheeks are about 4 inches long, and low down in front of the leg about 6 inches. The fringe on the breast and belly is quite inconspicuous, being represented by merely a few scattered long hairs. This skin, dressed, measures: head and body 6 ft. 2 ins.; tail 2 ft. 9 ins.; total 8 ft. 11 ins.

The other skin, measuring: head and body 6 ft. 4 ins.; tail 3 ft.; total 9 ft. 4 ins., is like the first in every respect except that it is not so grey and olivaceous in hue on the body, the hairs being more buff and the area between the flanks and the belly brighter ochreous.

These skins further attest the individual variation in the colour of Kathiawar lions. Their manes are longer, fuller and much blacker than those of any Indian lions' skins I have seen, and fully support Col. Fenton's claim of the existence of 'black-maned' lions in Kathiawar.

The dimensions of the skulls in inches and of the teeth in millimetres are as follows:—

Inches								Millimetres		
Total length.	Cond. bas. length.	Zygon.	Mast.	Waist.	Int. Orb.	Max.	Nasals.	Upper Carn.	Lower Carn.	Canine.
12·5	11·2+	7·8+	5·4–	2·3–	3	3·7+	4·2×2·4	36	25	27
12+	10·7	8·1+	5·4	2·3–	2·9–	3·7+	4·1×2·5	36	26	25

These skulls are fully adult and agree very closely with the skull from the Amreli District described above. They confirm the view that the sagittal crest and the postorbital ridges in front of it are better developed on the average in Indian than in African lions and that the auditory bullae are flatter. In both of the Jam Sahib's skulls they are so low as to be practically concealed by the mastoids in profile view. Also in both skulls the infraorbital foramen, although entire on the left side, is divided on the right side by a bridge into a small upper and a large lower portion. The skulls, however, are decidedly smaller than those previously recorded in this paper. In total length and width they do not surpass the largest skulls of African lionesses and in the dimensions referred to they bring the average length and width of measured skulls of Indian lions down to about 13 by 8½ inches, noticeably smaller, that is to say, than the average of lions' skulls from any district of Africa.

It is not unlikely, in my opinion, that the Kathiawar stock is deteriorating in size from inbreeding.

[Mr. Pocock's complaint in the footnote to page 651 is being repaired this year. H. H. The Nawab of Junagadh is kindly arranging to shoot two Lions during the forthcoming cold weather for the National Collection. It is a pity that death has prevented that fine sportsman Col. Faunthorpe from shooting a Lion for us.

Mr. A. S. Vernay has within the last 12 months provided us with no less than Rs. 14,300 wherewith to finance our collectors who are making a Survey of the Mammalia and Avi-fauna of the Eastern Ghats for the benefit of the National Collection at South Kensington.

In September this year we received for our own collection as a gift from Col. A. H. E. Mosse, I.A. of Bhavnagar, who had just shot it, the skin and skull of a mature male Kathiawar Lion. The dimensions of the skin are :—Length 8′6″ ; Head and body 5′9″ ; tail 2′11″.—Eds.].

THE BIRDS OF THE PROME DISTRICT OF LOWER BURMA.

BY

J. K. STANFORD, M.C., I.C.S.

WITH NOTES ON THE COLLECTION.

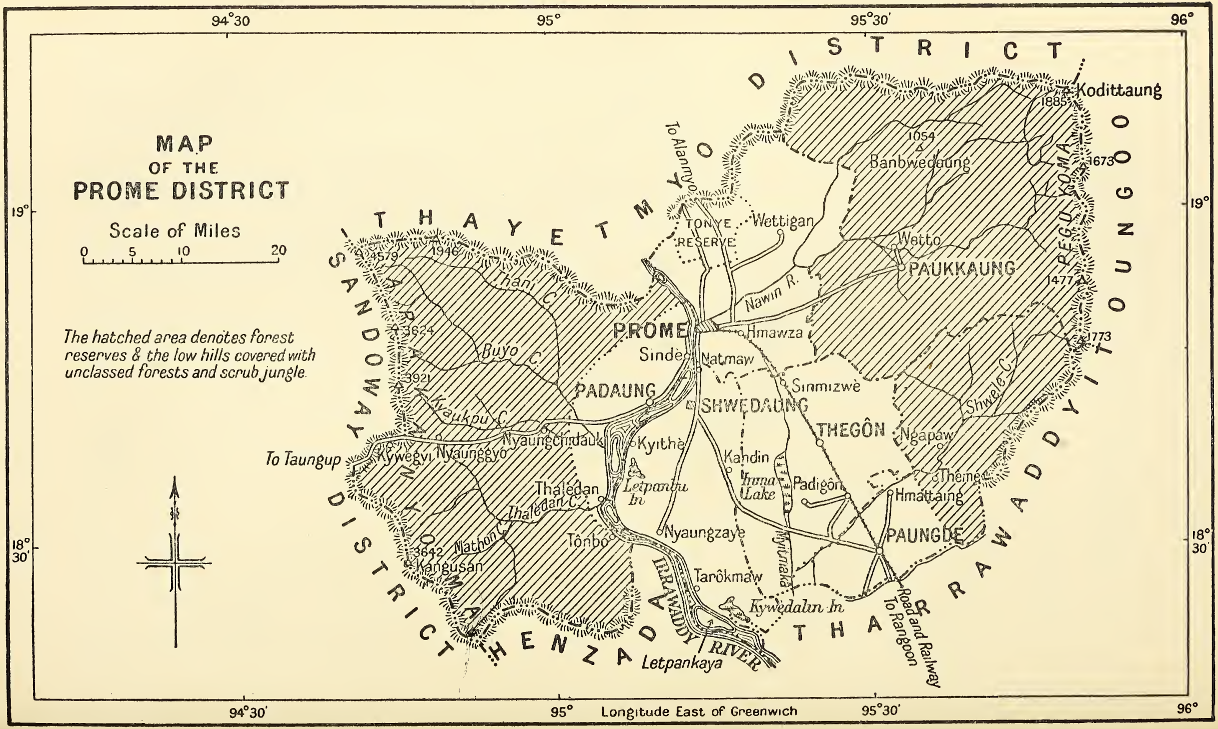
BY

DR. CLAUD B. TICEHURST, M.D., M.A., M.B.O.U., F.R.G.S.

(*With a map.*)

The Prome District which is about 2,930 square miles in extent, lies in the basin of the Irrawaddy between N. latitude 18°·18′ and 19°·11′ and stretches across both sides of the river above the head of the delta. It is bounded on the north by the Thayetmyo district of Upper Burma (which in Oates's day formed part, as did the whole of the delta, of the then Pegu Division), and marches with Henzada and Tharrawaddy on the south-west, south and south-east. On the west, the crest of the Arakan Yoma, from 3,000 to 4,500 feet in height, divides Prome from the Sandoway District of Arakan. From the watershed to the sea is nowhere more than 30 to 40 miles as the crow flies. Along the eastern side of the district, the Pegu Yoma divides Prome from Toungoo. In the south-eastern half of the district these hills attain a height of over 2,000 feet. About 20 miles east of Prome town the ground begins to rise, and most of the Paukkaung township, and the eastern half of the Paungde township, is a mass of tumbled foot-hills, rising gradually to the main Yoma. In the northern part of the district, and along the Irrawaddy valley on both sides of the river, much of the soil is sandy and very dry. At Prome the rainfall varies from 36 to 50 inches, and though paddy is generally grown over the whole of the district, this northern part, in crops and climate, approximates closely to the 'dry zone' of Upper Burma. In the south of the district the rainfall is from 60 to 65 inches and the great paddy plain of the delta commences south of the Inma lake down to the Tharrawaddy border.

2. Situated as it is between two ranges of little-known hills, with the wide Irrawaddy valley to split it up, and some 900 miles of forest country of every variety, the Prome District is probably of considerable interest ornithologically. In the west the Arakan Hills, which are a direct continuation of the Manipur, Lushai, Chittagong and Chin-Pakkoku Hills chain are crossed by the only road which at present runs from Arakan to Burma proper, the Taungup-Padaung road 110 miles in length. These hills are at the present day less known to naturalists than in 1883, when a military road, then much used by troops and officials (but now recovering from almost complete abandonment), ran through them. At that time, according to Oates, the whole Arakan division remained, from an ornithological standpoint, unexplored. It is probable that the Irrawaddy Valley, in places several miles wide, and down to which run small spurs of the Arakan foot-hills, constitutes the dividing line of a good many sub-species, and in this district it is certainly the main north to south migration route; while, owing to the lack of water, much of



MAP
OF THE
PROME DISTRICT

The hatched area denotes forest reserves & the low hills covered with unclassed forests and scrub jungle.

Scale of Miles
0
5
10
20
94°30
95°
95°30'
96°
19°
18° 30'
Longitude East of Greenwich
THAYETMYO DISTRICT
TOUNGOO
THARRAWADDY
THA
HENZADA
SANDOWAY DISTRICT
ARAKAN YOMA
PEGU YOMA
Koditaung
1885
1673
1477
1773
1054
Banbwedaung
Wetto
PAUKKAUNG
Wettigan
TONYE RESERVE
To Alanmyo
Nawin R.
PROME
Hmawza
Sindè
Natmaw
PADAUNG
Sinmizwè
SHWEDAUNG
THEGÔN
Ngapaw
Shwele C.
Kyithè
Kahdin
Inma Lake
Padigôn
Themè
Hmattaing
PAUNGDE
Myitmaka
Nyaungzaye
Tarôkmaw
Kywedalin In
Road and Railway To Rangoon
Letpanbu In
Thaledan
Thaledan C.
Tônbo
IRRAWADDY RIVER
Letpankaya
Nyaungchidauk
Nyaunggyo
Kywegyi
To Taungup
Kyaukpu C.
Buyo C.
Thani C.
4579
1946
3624
3921
3642
Mathon C.
Kangusan

the bird life from December to May is concentrated along the valley or its subsidiary streams.

3. Very few ornithologists have ever worked the district. When Oates published his *Birds of British Burmah* in 1883, he was familiar with Prome, Thayetmyo, and the Taungup road up to Nyaunggyo at the crest of the Yoma, but beyond occasional references made by him to Prome District, and the records he quoted of Captain Fielden, who had been formerly stationed at Thayetmyo, he probably knew far more of the eastern side of the Pegu Yoma much further to the south. He apparently also sent collectors to work the hills with a Mr. Theobald, but it cannot be said whether the birds collected by them were on the Sandoway side of the water-shed or not. Blyth described birds from the Arakan Hills, as did Hume from 'Upper Pegu' in the region of Thayetmyo, but many of their observations are, even to-day, unconfirmed. Since that day, the only naturalist who appears to have worked the area is Mr. J. M. Mackenzie, I.F.S., who was mainly on the eastern side of the Irrawaddy, and whose notes I have not yet been able to obtain. We cannot find that anyone has so far put on record an account of the birds of the Prome district. The present account is based merely on references by Oates, some rough notes made over a period of 23 months between 1927 and 1929, and a collection of 411 skins comprising 209 species, which was made with the aid of a skinner, Mr. Henricks, most kindly lent by the authorities of the Bombay Natural History Society, from mid-January to mid-April 1929.

4. During these three months it was not possible to do more than attempt to make a representative collection of the birds of the district for a few hours a day. Though most portions of it were visited, no collections were made in the main eastern forest area of Paukkaung and Paungde, and no chance occurred to visit the hills which form the northern boundary of the district on the Thayetmyo side. This area might well repay the ornithologist one day, though Oates apparently collected on the same hills between Thayetmyo and Toungoo, and Fielden at Thayetmyo. In April 1928, three days were spent at Nyaunggyo (2,400 feet) at the summit of the Arakan hills on the Taungup-Padaung road, and about a fortnight in April 1929. Here with the help of Mr. A. K. Potter, I.C.S., birds of 49 different species which had not yet been met with previously in the plains, were collected. The bird-life was in fact found to be concentrated mainly above the 2,000 feet line in the cool of the evergreen jungle, between the two main watersheds. As 7 or 8 of these species do not appear to have been recorded from 'Pegu' during the 30 years in which Oates was collecting in it, it is clear that the Arakan Yoma would amply repay a closer investigation. It is completely uninhabited, extremely difficult to get about in, and away from the road is infested with tigers, which caused much trouble to Survey of India parties during the cold weather of 1928–29. Further south to the Henzada border, and northwards through Thayetmyo and Minbu, these hills on both sides of the main water-shed are likely to remain a *terra incognita* to the ornithologist for a good many years to come.

The average rainfall on the Arakan side and probably up to Nyaunggyo on the Prome side is over 200 inches, but on the Prome side below about 1,800 feet it would be hard to find, from December until the rains more desolate, waterless jungle than covers these hills, quite unculturable and with practically no vegetation of any kind except bamboo. The Arakan Yoma seems to act as a screen against the rain clouds from the Bay of Bengal, precipitating all which are not very high on their western slopes and the hills up to Nyaunggyo. The fall in the Padaung township proper, which comprises one-third of the district, is said to be less than further east.

Andaman Jungle Crow (Corvus coronoides andamanensis). 105.

Burmese—*Taw-chegan.*

Common, except in the Arakan Hills where I did not see it at all in April 1928 or 1929. In the Irrawaddy Valley and elsewhere, it frequents the better-wooded villages. [Specimen not seen.—C.B.T.)

Burmese House Crow (Corvus splendens insolens). 161, 188, 256–259.

Burmese—*Chegan.*

Extremely common everywhere, except in the Arakan hills where in April 1929 I saw only two pairs, both at halting places along the road. Oates says the breeding season commences ' about the middle of March '. In 1928 and 1929 they started building or repairing nests in my garden about the first week in February, though I did not see fledged young before April 30th. I have seen them on more than one occasion hawking flying ants, and it was remarkable at Prome how often in the early mornings the entire colony would fly off suddenly across the Irrawaddy, returning a few minutes later. [Specimens not seen.—C.B.T.]

Red-billed Blue Magpie (Urocissa melanocephala magnirostris).

Oates recorded the bird from Thayetmyo and I saw individuals on both sides of the river but failed to collect any.

Green Magpie (Cissa c. chinensis). 411.

Oates describes it as ' abundant ' on the Pegu hills and breeding in April. I shot a female at Nyaunggyo (2,500 ft.) in the Arakan hills on April 14, 1929, with a hard-shelled egg in the oviduct. This pair, the only ones I ever saw in the district, were in bamboo jungle and extremely shy, though their note was frequently heard. I have no reason to suppose they occur below the line of evergreen forest, as suggested by Oates.

Burmese Tree Pie (Dentrocitta rufa). 7,25.

Common, especially in the drier forests in the north of the district. Not seen in the Arakan hills in April 1929.

[The whole of Burma south of the Chin and Kachin hills is said to be inhabited by *kinneari*, characterized as being a dark bird above and below, the colour of the head and back blending, w. 137–151, t. 195–241. These two Prome birds do not at all tally with this description. They are distinctly pale birds and the grey of the neck is sharply separated from the rufous back. ♂, w. 150–159, t. 255–270. I can match these birds with some Bengal ones except that the tails in the former are considerably longer. I can also match them in colour with some Punjab birds. Over the very extensive range of this *Dendrocitta* specimens may be found which upset any grouping into races by coloration as there is much variation. There are also apparently specimens

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[Mr. Stanford is entirely responsible for the Introduction and the notes on each species. Dr. Ticehurst is responsible for the remarks on the specimens collected. The order followed is that of the *Fauna* edition ii., and the nomenclature also follows that work in most cases. References to ' Oates ' are to his *Birds of British Burmah*, edition 1883, and where ' Pegu ' is referred to, it means Pegu Division as constituted in his day, viz., British Burma except Arakan and Tenasserim. ' S. B.' refers to the second edition of the *Fauna*. The numbers after the scientific name are collection numbers.

which upset an arrangement founded on size. However this may be more apparent than real, as the material available in the British Museum, though extensive, often lacks any data as to sex and, what is more confusing still, some, I am sure, are wrongly sexed.

In the *Ibis* (1922, p. 537) I 'lumped' all the birds from India (except N.W.) and Burma under one race *vagabunda* and drew attention to the fact that Southern Indian birds are smallest. In the *Fauna* ed. ii. Mr. Baker unites the small dark South Indian bird (*rufa*) with the pale large N. W. Indian bird, which arrangement I cannot follow, and divides my *vagabunda* into three races, *vagabunda*, *sclateri* and *kinneari*, but it seems questionable whether the problem is any clearer by this treatment.—C.B.T.]

Black Racquet-tailed Magpie (Crypsirhina varians).

While Stuart Baker remarks that it has 'its headquarters in Pegu, extending up the valley of the Irrawaddy, to some way north of Thayetmyo', Oates says 'in Pegu it is rare at Prome and I have only once observed it in Thayetmyo, but from Prome southwards it becomes common. . . .' I have never seen it there and should say its place was entirely taken by the next species. It is not uncommon in Insein.

Hooded Racquet-tailed Magpie (Crypsirhina cucullata). 26, 83, 120, 165, 166.

As Stuart Baker remarks, it is a bird mainly of the dry zone, but is found a considerable distance south of Prome where the rainfall is well over 60 inches. Not seen in the Arakan hills. Oates did not find it below Palo in the Thayetmyo district. One obtained in January was feeding on seeds of 'Shabin' (*Acacia catechu*). (Stuart Baker's references to it being obtained 'as far north as Pyinmana *on the Chindwin*' appears to be a mistake. Pyinmana on the Rangoon-Mandalay line is in the Yamethin district, not far north of Toungoo.)

[Two males w. 106–109, t. 170–180, four females w. 105–112. t. 167–187. Birds a year old differ from the adult in having the grey parts tinged with brown, less gloss on the head, flight feathers and tail brown instead of black, edges of the secondaries not white and the whitish collar absent.]

Burmese Jay (Garrulus l. leucotis).

Oates says : 'West of the Sittang river it occurs on the hills near Prome where Mr. Olive assures me he has seen it'. This record was apparently modified in the *Fauna*. I have never seen it or heard of it and, if what Olive said is true, it must occur at a considerably lower altitude than usual.

Indian Grey Tit (Parus major cinereus).

Stuart Baker (i. 44) records it from 'Western Burma' and as far east as Maymyo. Oates records it from Thayetmyo and to the 'west of the Irrawaddy towards the foot of the Arakan hills', probably on the Taungup road. I shot a Tit which I unfortunately did not preserve, in April 1928, on this road at about 1,200 ft. which appeared to be *cinereus*. Seen nowhere else.

Burmese Nuthatch (Sitta castaneiventris neglecta). 151, 156, 233.

Blanford and Oates describe it as occurring 'throughout Pegu up to the Irrawaddy river on the west'. Stuart Baker says 'through the eastern hill-ranges of Burma', and 'never in the plains'. Oates says : 'Common in the plains, but I did not observe it on the hills'. I shot a pair at about 100 ft. in the Tonye reserve, north of Prome on the 11th February, 1929, and another bird at Ngaphaw (200 ft.) in the Pegu Yoma foot-hills in February 1928. This one appeared to have been feeding on ants. I frequently saw others in the plains, but this species appears to be replaced by *frontalis* in the Arakan Yoma.

Velvet-fronted Nuthatch (Sitta frontalis corallina). 340.

Oates describes it as widely distributed in Pegu but common on the hills. I saw a good many at Nyaunggyo (2,500 ft.) in April 1928 and 1929 including two pairs, one of which appeared to have full-fledged young with them.

Burmese White-crested Laughing-Thrush (Garrulax leucolophus belangeri).

The common Laughing Thrush of the plains and found in small numbers up to 2,500 ft. on the Arakan side. Very frequently seen in flocks on the main roads near Prome, regardless of motor traffic.

[These birds from the plains are *belangeri*, but it is questionable whether the Arakan Yoma birds will prove to be of the same race.]

Black-gorgeted Laughing-Thrush (Garrulax pectoralis pectoralis). 382 (juv.).

Oates describes this species as very common throughout the northern half of Pegu 'or perhaps only down to the latitude of Prome'. I only collected one juvenile at about 2,000 ft. near Nyaunggyo. Saw others close to Prome Town, but it was distinctly scarce and local.

[This specimen is in full juvenile dress. A bird in similar dress from Assam is more rusty below and less olivaceous above than this specimen. An old skin of an adult labelled 'Arakan' however does not differ from Sikkim birds.]

Necklaced Laughing-Thrush (G. moniliger fuscata).

Oates says it is found 'over the whole of Pegu'. I never saw it, though it occurs in Insein further south.

Striated Babbler (Argya earlii). 51, 241.

Oates describes it as abundant in Pegu but not seen by him in many years at Thayetmyo. I shot one of a party of three in Kaing grass at Shwedaung on 22nd January, 1929, and another out of a large party on 3rd March. Probably fairly common along the Irrawaddy valley.

[Striated Babblers, whether in Sind or Prome, appear to be *water* birds, and this may perhaps have something to do with the fact that in this species there is no geographical variation.]

White-throated Babbler (Argya gularis). 12, 80, 81, 308.

Oates describes it as confined to the northern portions of Pegu in the Irrawaddy valley; 'to the west . . . probably occurs up to the foot of the Arakan hills, and south as far as Prome'. It is not common as far as I can see, more than 20 miles south of Prome (Kandin) and is confined to the drier northern portions of the district.

[3 ♂♂, w. 88–89. ♀ 89. Tail ♂, 145–163. ♀ 150. The *Fauna*, ed. ii, gives the wing as 78–83, tail about 140.]

Grant's Slaty-headed Scimitar Babbler (Pomatorhinus schisticeps mearsi). 402.

'Manipur to Arakan' (B. & O. i. 116). Hume recorded it from Thayetmyo and Blyth from Arakan. Oates never met it. I shot one at about 2,500 ft. near Nyaunggyo on 12th April, 1929, hopping about on the edge of bamboo jungle and saw others on the stream a few hundred feet lower down the same ridge. This appears to be an extension of its known range.

Tweeddale's Scimitar-Babbler (P. nuchalis). 235.

Oates found it common at Thayetmyo and Mackenzie found a good many at Prome (S. B. I. 208). I got a female out of a pair in bamboo jungle at about 300 ft. on the road from Theme to Ngaphaw on 1st March, 1929. This was in the Pegu Yoma foot-hills.

Blyth's Scimitar Babbler (P. ferruginosus albigularis).

There must surely be an error in Stuart Baker's description of this bird 'breeding on the Taok plateau, 60 miles east of Prome.' I have never observed it, nor did Oates, west of the Sittang.

Burmese Red-capped Babbler (Timalia pileata intermedia). 122, 277, 283, 310.

Oates described it as very common all over Pegu. Several were obtained at Tarokmaw, in the south of the district, Sinde (west of the Irrawaddy) and Prome. Probably common in *Kaing* jungle, but very rarely seen and exceedingly difficult to obtain.

[This is *T. pileata jerdoni* of the *Fauna*. Mr. Kinnear has rightly pointed out that *jerdoni* came from the Khasia Hills and is a synonym of *bengalensis* (Bull. B.O.C. xlv, p. 9). He therefore named the Burmese bird *intermedia.*]

White-headed Shrike-Babbler (Gampsorhynchus r. rufulus). 383, 409.

Oates received one from Nyaunggyo. I shot two here between 2,000 ft. and 2,500 ft. between 1st and 12th April, 1929, both in dense evergreen bamboo jungle along streams. They were not at all shy and seemed very interested in a party of human beings.

[These are precisely as Sikkim birds. One of them, on 13th April, is moulting the head and body feathers. The old feathers of the crown are red and the new ones white. It is interesting to note that the birds from the east side of the Irrawaddy (Toungoo Hills) have been identified as *torquatus*.]

Indian Yellow-eyed Babbler (Pyctorhis s. sinensis). 125, 326.

Probably fairly common except in the hills where we did not notice it at all. Henricks shot one at Tarokmaw on 5th February, 1929, and another at Sinde on 15th March, 1929. The former was on a *bombax* tree.

Malay Spotted Babbler (Pellorneum ruficeps sub-sp ?). 232.

A babbler of this species was not uncommon in the foothills of the Pegu Yoma wherever coarse grass and bamboo abounded. I obtained a male near Ngaphaw on 28th February, 1929, out of a pair. They are extremely shy skulkers when disturbed. I saw one or two at 3,000 ft. in similar country in the Arakan Yoma but did not obtain any.

[I cannot match this bird entirely with any known race of *ruficeps ;* further specimens are desirable. *Pellorneum minus* described from Thayetmyo, one might expect to inhabit the Pegu Yoma. The Arakan Yoma bird might be different.]

Streaked Wren-Babbler (Turdinulus brevicaudatus striatus). 327, 349.

Oates never met with it in Pegu and this race has not been previously recorded south of Manipur.

I saw several along the Nyaunggyo stream in April 1928–29, where it was apparently breeding, judging by the way single birds hopped about near me uttering their low chiding note. This was in damp evergreen jungle at about 2,500 ft. On one occasion I also saw several together which appeared to be a family party. They resembled dark immature Red-breasts and spent most of their time feeding on the ground.

Assam Black-throated Babbler (Stachyris nigriceps sub-sp ?). 344, 384.

Oates found it only on the eastern side of the Pegu Yomas. I got one at Nyaunggyo on 4th April, 1929, out of a travelling party in low undergrowth by a stream which were moving about and feeding like Tits. I shot another out of a pair in bamboo jungle at 2,000 ft. on 9th April, 1929.

[These two birds are less rusty, more olive brown above and paler below than the typical race (Nepal). They do not belong to the Assam race *coltarti* in whose range Baker includes Western Burma. They match *davisoni* (Pahang) best, though they are a trifle paler on the underparts than most. A larger series in fresher plumage is required to determine the Arakan race.]

Gyldenstope's Babbler (Mixornis rubricapilla sulphureus). 84, 236, 311.

Oates notes it as found 'commonly over the whole of Pegu except in the drier portions between Thayetmyo and Prome.'

I shot 3, all very shy and skulking, in dense bamboo jungle, all from 20 to 40 miles south of Prome. The testes of a ♂ shot on 28th March, 1929, were much enlarged. Those obtained were all east of the Irrawaddy.

[These have finer throat streaks than any *rubricapilla* I have examined, a large series ; they have consequently nothing to do with *pileata* with coarse streaks on this part. I can match them with some birds from the Shan States and N. Siam except that the latter are mostly more rufescent on the back. For the present I must leave them as *sulphureus* (Rippon Bull. B. O. C. xi), which is probably the same as *minor* Gyldenstolpe (Lat Bu Ka.]

Tickell's Babbler (Pellorneum tickelli sub-sp.). ♂ 48.

A male of this bird was shot on 13th April, 1929, out of a pair which I watched hopping about on the edge of a water-fall in the Nyaunggyo stream at 2,500 ft. Oates found *P. tickelli* common in evergreen forest on the east side of the Pegu Hills.

[This single bird is, I have no doubt, a race of *tickelli*. It corresponds to nothing in the British Museum where I compared it. It must be an undescribed form, but I wait further examples from Arakan.]

Nepal Babbler (Alcippe nepalensis sub-sp ?). 331, 396.

Oates did not meet with it and had only one record from the Pegu hills. I shot a ♀ on 2nd April, 1929, and another on 11th April, 1929, at Nyaunggyo in evergreen forest. The active movements of the first made me think it was a Flycatcher.

[These two birds certainly belong to an undescribed race differing considerably from *nipalensis* on the one hand and *fraterculus* from the Shan States on the other. I think it best to await further specimens before describing it however.]

Arakan Quaker-Babbler (Alcippe poioicephala phayrei). 363, 406.

Oates found ' *Alcippe phayrei* ' abundant in evergreen forest on the eastern spurs of the Pegu hills, but not elsewhere in Pegu.

I obtained two near Nyaunggyo, the first at 2,300 ft. bamboo out of a pair on 5th April and the second on 12th April, 1929, out of a pair at 2,000 ft. These were creeping about in thick jungle, or creeper, and I had little chance to observe their habits.

[These two birds from Nyaunggyo are of course *phayrei* which was described from Arakan.]

Chestnut-headed Staphidia (Staphidia castaneiceps). 400.

According to Stuart Baker, not previously found south of Lushai.

I shot a ♂ out of a pair at 2,000 ft. near Nyaunggyo. Both birds were very tame and flitting along the bank at the edge of the Taungup road. I found a nest of moss in a bank just opposite the place, and saw two other nests of the same type along the road under overhanging ledges. I also saw a pair here feeding apparently on seeds of Telugu-wa (*Dendrocalamus longispathus*). The bird I shot displayed a broad white-tipped tail and was very tame.

[I cannot separate this single bird from Assam examples. ♂, wing 59 mm. The wing measurements in the *Fauna*, ed. ii., pp. 66–70 are not correct. I measure a series as 58–62 mm. In the description in the *Fauna*, p. 310, the upper parts are described as *greenish* brown instead of *greyish*.]

White-Bellied Herpornis (Erpornis x. xantholeuca). 346, 362.

Oates describes it as common and widely distributed in forests. Two males were obtained on April 3rd and 5th between 2,000 ft. and 2,400 ft. near Nyaunggyo along the Taungup road.

[These are too pale for *interposita* and are a slightly paler shade than Sikkim examples]

Common Iora (Ægithina t. tiphia). 74, 150, 155, 281.

Common all over the district except in the forests. Oates noted that it did not ascend the hills ' to any great height.'

Gold-fronted Chloropsis (Chloropsis aurifrons aurifrons). 317.

Oates describes it as spread throughout Pegu but confined to the plains and lower hills.

Henricks obtained the only one seen or obtained on 14th March, 1929, at Sinde, on the west bank of the Irrawaddy.

Orange-bellied Chloropsis (Chloropsis hardwickii malayana). 361.

Blyth recorded it from Arakan, but Oates did not meet with it in Pegu.

I shot a male out of a pair at Nyaunggyo feeding on the seeds of a flowering tree. The note resembled a cat mewing.

One *Chloropsis* was common up here, but may have been the next species, as I only collected two specimens.

[This single *Chloropsis* (♂, wing. 89·5 mm.) is too small for typical *hardwickii* and at present I must place it under the small race *malayana*. The wing of *hardwickii* measures 93·5-99·5 (large series). There are other small differences too in this specimen which may however be individual. More specimens are required from Arakan.]

Burmese Chloropsis (Chloropsis cochinchinensis cochinchinensis). 354.

Oates says it is abundant in the higher hills of Pegu in evergreen forest. I shot a male on 4th April, 1929, and saw a good many others nearly all in pairs. These were only on the tops of the highest ridges at 3,000 ft. in open tree-jungle at Nyaunggyo.

[This is *icterocephala chlorocephala* of the *Fauna*. Kloss (Malayan Branch of R. As. Soc. iv. 1926) has shewn that *cochinchinensis* is the older name.]

(*To be continued.*)

THE PANTHER AS I HAVE KNOWN HIM.

BY

Lt.-Col. A. H. E. Mosse, I.A., F.Z.S.

PART III.

(*With a plate.*)

(*Continued from page 366 of this Volume.*)

III. Sitting up Experiences.

In giving some account of personal experiences I shall confine myself to those which present definite points of interest or are otherwise illustrative, either of habits of the panther which I have already described, or of lessons to be drawn by the observant shikari.

I shall begin with an incident which impressed on me, more than any other, the superlative patience and watchfulness of the panther. The month was May, the scene a spot on one of the low rocky hill ranges of North Gujarat. A pair of panthers, male and female, had been located in a cave near the highest point of the range. There was no likelihood of a beat succeeding in driving the beasts from their cave, so I decided to sit up and fixed my *machán* in a good tree, with several bushes around, in a flat space, some four hundred feet below the cave. My loophole was facing the cave which had more than one exit concealed by high grass and thorn bushes. The slope of the hill in front was comparatively open so that the chances were against an animal descending the hill unobserved. I had tied up, though I do not recommend this ordinarily, both a goat to attract attention in the first instance, and a *pada*—young male buffalo—which I hoped would induce the male to attack; as a rule, of a pair together, it is the female which kills unless the quarry be beyond her powers.

I was in position at 5 p.m. At 6.15 a panther—female—appeared from behind the screen of bushes covering the cave and looked towards the goat. The *pada* was lying down and not visible from her position. She then moved downwards a short distance and lay down on a rock in full view, with paws outstretched before her like a dog, some seventy yards or so from the *machán* and perhaps one hundred feet above me. There she remained, with an occasional change of position, lying or sitting, for the next half hour. Now and then she gave a casual and seemingly uninterested glance towards the goat, and there was not a point in the foreground to which her gaze was not from time to time directed. But her general attitude was one of apparent boredom emphasized by the great yawns to which she gave vent at least a dozen times. At the end of half-an-hour she moved a little nearer and sat down again for a while, then another move to a spot not more than forty yards away where she settled down for a longer spell. In this position she was detected by a couple of peafowl on a ledge to my right front above her and, for ten minutes before flying away, they patrolled the ledge, every now and then craning their necks over the side of the ledge to make sure she was still there, while their warning note continually announced her presence to the jungle—of all which she took not the smallest notice.

I could have shot her with ease in her second position, in her first she did not offer a good target; but I hoped for the appearance of her lord and master and held my hand. It was 7.30 p.m. and the sun had set when, after a vigil of a full hour and a quarter, she moved down, presumably contemplating an attack on the goat, who, in spite of the peafowl's warnings, had shown no sign of being aware of the enemy. But at twenty yards she checked, catching sight of the *pada* for the first time, and disappeared from view. I thought that perhaps she had gone to call her mate but, as we ascertained afterwards, he had gone off on his own on the other side of the hill. I neither saw nor heard anything more until, at 7.50 p.m., nearly dark, she went for the *pada,* but he shook her off with ease and she retired. A *pada* over six months old is too much for the average female leopard in these parts. At about 8.10 p.m. she killed the goat but the rope was too long and she managed, before I could shoot, to drag it into the shade where I could not make her out at all. I had no spotlight and so I gave up and let her finish her meal in peace.

This was an instructive evening. Although my *machán* was well concealed, the goat was in the direct line of sight between my loophole and the panther as she lay on the hillside and had the cover been thicker and had I failed to observe her from the beginning, it is long odds that, during her patient watch of over an hour, some incautious movements would have given me away to her keen eyes. Again, during that last half hour before she killed, had I not known that she was somewhere very near, it is equally probable that I might have betrayed myself to her equally keen ears, by some slight sound. Finally the error of too great a length of rope between goat and peg, unless absolutely in the open where it could not matter, was driven home once for all.

Though the above was perhaps the most noteworthy incident of the kind, I have on several other occasions seen a panther stretched out on a rock above his kill or a bait for more than half-an-hour at a time and, as often as not, that has been all I have seen of him; the erection of the *machán* had perhaps been observed or something had aroused suspicion. Two old and cunning panthers I remember in particular, one at Idar and one in the Danta hills, who defied me time and again and were never brought to book. The second of these did once return to a kill at about 10 p.m., and I waited for him to settle down, but he just strolled around and then leisurely decamped, not to appear again. I meant to have tried an all-night sitting for him after that, but was not able to manage it.

On another occasion, sitting in a low and unavoidably conspicuous *machán* at the foot of a hill near a village called Chelana, in the little State of Sudasna in the Mahi Kantha Agency, I suddenly observed a panther sitting on his haunches, looking at the *machán,* about eighty yards away. He sat for five minutes, then disappeared for good. In this case he may have spotted a movement of mine before I saw him or merely did not like the look of the *machán.* The mistake here had lain in 'chancing' a bad *machán* owing to unwillingness to move the kill—a natural one. It is undoubtedly wiser not to move a kill if this can be avoided, but, as I have said before, some panthers will follow the drag of a kill moved for a little distance and it is better to risk their not doing so rather than to occupy a position foredoomed to failure. In the case of an old hand your only chance, as a rule, is a natural 'kill' within shot of a site for an inconspicuous *machán* and out of sight and hearing of his daytime retreat.

With the average panther, perhaps the best method of dealing with a natural 'kill' in a position unsuitable for sitting over is to remove the 'kill' quietly and tie up a goat within easy hearing of the spot where the kill has lain. It may be worth while to give an account of an instance in which this plan was adopted with success.

The scene lay in the Bhavnagar State in Kathiawar, adjacent to the eastern borders of the famous jungles of the Gir. The panther had left his 'kill', a donkey, half concealed under a bush on the lower slopes of a hill and retired to a cave higher up the hill. The hillside was bare except for a few small bushes of the *bher* thorn and some clumps of candelabra cactus. There were no trees, no bushes of any use near the 'kill' and the ground was too hard to dig a shelter-pit. The local shikaris wanted to put up a *machán* on four poles in the open—an entirely futile idea. Alternatively they proposed to drag the 'kill' to the nearest practicable tree, 500 yards away, inviting me to sit over it there and the panther would surely come ! I declined to share their optimism.

To my mind there was nothing to be done with the 'kill', 'natural' though it was. The only hope lay in a live goat. I could find no suitable spot within hearing of the panther's cave, but I saw distinct possibilities in the clumps of candelabra cactus—which the local *pagis* overlooked—near enough to the spot where the 'kill' was lying, and I soon selected a couple of clumps of cactus, growing together on the bank of a tiny *nala* 200 yards away, with a thorn bush filling the space between them. On the ground amidst the cactus and thorn I was able, with little labour, to make a most satisfactory shelter, with nothing about it to arouse suspicion and impregnable to a charge. It only remained to have the 'kill' entirely removed, that the panther might have no choice between fresh and somewhat high meat.

The scheme worked strictly according to plan, the panther came down at sunset to visit his 'kill', found it gone but heard the goat calling at a little distance. In due course he came to investigate and gave me an easy shot before dark, without scathe to the goat.

I have referred to the small hill of Chelana. There were, in fact, two adjacent hills covered with boulders of varying sizes, beneath which cave-like ramifications provided ample daytime shelter for the beasts of night. They lay in the path of panthers or an occasional tiger travelling between the hilly systems of Palanpur on the west and Danta to the north and east, and it was rarely that a week passed without a panther or two in occupation, and these might often be seen basking on the rocks in the early morning sunshine or, during the hour before dusk, surveying the landscape before starting on the nightly prowl. These hills provided me with several interesting experiences at different times.

On one occasion at Chelana I sat up for a pair of panthers, supposed to be a small male and a female. One appeared on the rocks above me an hour before sunset, the other ten minutes later. Through the glasses I came to the conclusion that they were a mother and big male cub, very nearly as big as herself. In such circumstances the average panther affects, for most of the time until he decides on action, an air of complete indifference to the tied-up bait below. In this case, however, it was noteworthy how the attention of the cub was concentrated on my goat, off which he could hardly take his eyes. At length he went up to his parent and put his nose against her cheek. She licked his head and then he left her and moved down to a lower rock. It was exactly as if he had asked permission to try and tackle this business by himself and she had bid him go, with her blessing—and a warning to go slow and not rush things. From the lower rock he watched the goat intently for five minutes, then slipped down into the bushes below. Immediately afterwards the mother climbed a small tree that grew alongside the rock on which she had been sitting, apparently in order to obtain a better view.

Some ten minutes later the cub came into my sight again through a peephole, creeping very slowly and with the utmost circumspection. About ten yards distant from the goat, who did not see him—he was partially concealed by a small bush and some grass—he lay on his stomach, motionless, for five minutes, then he moved forward at a crawl, inches at a time and with frequent pauses. He took not less than fifteen minutes to cover ten feet of ground: all the while his tail never ceased twitching, while his eyes remained fixed with the utmost intentness on his quarry. One could sense the conflict between the impatience of his youth and his determination to obey parental instructions and go slow, his whole body tense yet quivering with excitement. It was fascinating to watch him. At length he was only fifteen feet away, now fully visible through my loophole, while his tail whipped from side to side. One part of me would have liked to wait and see what sort of a job he made of the attack, but that would not have been fair to the poor little goat, still all unsuspecting, and I made an end. It had been most interesting.

The following evening I tried to tempt the mother out but without success. I heard her, however, quite near, calling for her lost son, a peculiar murmuring sort of note which gradually changed into the well-known 'sawing'. This 'sawing' is, I think, usually uttered as a call to a mate, or, as in this case, a cub. I saw more of this lady not long after when she had taken to herself a husband. I had had a *pada* tied up for a possible tiger near a good tree well out in the open, some 150 yards from the bushes at the base of the

Chelana hill, and it was killed by this pair of panthers. I sat up an hour before sunset but, in view of the position of the 'kill', did not expect to see anything of the panthers before dusk. However, after half-an-hour I heard them—there is no reticence about a panther's courting—and they shortly appeared out in the open. For the next three-quarters of an hour I was treated to an exhibition of the panther's married life. The lady was not exactly backward in coming forward—in fact, I never saw a more brazen hussy!

The daylight was beginning to fail when they approached my tree and the female came and stood over the 'kill'. Just then the male, who was under my tree, gave a sort of whinnying call; she at once turned tail and joined him and they retired to the shelter of the bushes at the foot of the hill. I wondered if my presence had been detected, but next moment the explanation came with the loud moaning cry to which a hyaena sometimes gives vent when in the neighbourhood of a panther's 'kill' and he knows the owner is near by. Presently I saw him fifty yards away. Twice he made a circle round the 'kill', keeping up his peculiar moaning. At length he came up to the 'kill' and started his meal, but did not really settle down to it, being obviously uneasy.

By this time the daylight had gone, but the moon was near the full and its light was bright. The hyaena had been at the 'kill' for about five minutes when the panthers made their appearance again, strolling leisurely up, and both lay down some thirty paces away, watching the hyaena but, apparently, making no hostile demonstration. The hyaena was clearly worried: he moved a few feet away from the 'kill', began his moaning again, and then, after a couple of minutes' hesitation, retired from the field. After he had been gone a few minutes the male panther walked up to the 'kill'. I took my opportunity and shot him. It had been an evening that afforded an exceedingly interesting example of the manner in which sitting up may provide one with fascinating peeps into the intimacies of Jungle life.

A friend of mine once witnessed a fight between a small panther and a hyaena, over a 'kill', in which the latter had the best of it, and there seems some reason to believe that the panther holds the hyaena, with his powerful jaws, in considerable respect. But the respect is mutual. The hyaena ordinarily is a coward and I have seen one decamp with the utmost celerity at the sound of a growl from a panther returning to his 'kill'. In Somaliland I have seen a male panther give way on the approach of a couple of hyaenas but the odds were heavily against him, as in a few minutes there were half-a-dozen hyaenas on the 'kill'—and this was the big spotted hyaena of Africa. In my experience the striped hyaena of India is very chary of settling down to a 'kill' if he knows the panther to be anywhere about.

Once mated, a pair of panthers will keep together for some time, but if she lose her mate in the early days the female is not long in consoling herself. The lady of whom I have been telling provided herself with another husband within twenty-four hours! I have known precisely the same thing occur in a second case.

When a pair of adult panthers is working together it is almost invariably—I have seen but one exception to the rule—the female who makes the 'kill', unless the quarry be beyond her powers. I have never known a female kill the half-grown buffalo of which a male will make short work. As says Kipling, 'the female of the species is deadlier than the male', or it may be that the male is a believer in the maxim 'let the women do the work'!

Another case of a mated pair which the attendant incidents make worth recording occurred in a jungle in the Idar State. I had been sitting over a goat for an hour listening to the row the panthers were making close by when the female, who had not previously showed herself, rushed the goat, seizing it as usual by the throat. The goat was a fairly big one and for a few seconds there was a struggle, during which I could not make sure of my shot. Then, when things had quieted down, the goat was apparently done for and there was no hope of saving it, so I withheld my fire, hoping the male panther would appear. The spectacle was unusual, the panther, not a large female, was sitting on her haunches holding the seemingly dead goat on its feet in a standing position, maintaining a tight grip on the throat. As the body of the goat swayed against her she pushed it gently away with a fore-paw. This happened two or three times. For, I should think, two minutes, she remained like this, then relaxed her grip and the goat collapsed. She surveyed the body for a few moments, then seized it by the head and attempted to drag it away into cover. In this she failed; the goat was firmly tied by a rope to a stump. Then she pulled at a hind leg, without success. Again she tried another leg. This time it seemed to me that the rope showed signs of slipping off the stump. I decided to take no risk and fired. She dropped dead and I called up my men. Just as they arrived the 'dead' goat gave a kick and stood up! On examining I found that, although it had recovered from the temporary strangulation, it was undoubtedly badly wounded; so I put the poor thing out of its pain.

This incident illustrates how the panther ordinarily kills a goat or similar animal by strangulation, rather than by the wounds it inflicts, though these would no doubt as a rule eventually prove fatal. It is perhaps this habit of holding its victim's throat in a strangle grip for a minute or two, or even longer, which has given rise to the common belief that the first thing a panther does, after killing, is to drink the blood of its victim from the throat. I believe this idea to be entirely erroneous. My reasons are, in the first place, that if you examine a goat killed by a panther you will ordinarily find only the two punctures on each side of the throat. During the continuance of the grip these puncture holes are occupied by the panther's fangs and no blood could flow through them. In order to draw out the blood the grip would have to be shifted, in which case there should be other fang marks, but of such you will, as a rule, find no sign. Again, if the panther were to suck the blood while gripping the throat, one would, while watching the performance, as I have done, observe the motions of his own throat. But one sees nothing of the kind—there is no sign of any motion of sucking or swallowing while the panther maintains the grip. A final conclusive argument, to my mind, lies in the absence of blood on the throat of a panther's kill, or on the ground below. If a panther sucked blood from the throat, the action would necessarily induce a flow of blood from the wounds which would continue for a time after he had released his hold. But, in actual fact, it is remarkable how rarely one sees any blood at all. It is likely enough that a beast may lap up some of the blood which he finds pouring out when he tears open the stomach—I have known a lion do so—but that is another matter. The story one hears now and then of a panther—or tiger for that matter—who has left a kill uneaten, having contented himself with drinking the blood is, I am convinced, based on a delusion.

To return to the Idar jungle. I was sure that the male would come to look for his mate, so tied up a *pada* at the same spot. This he killed and I sat up again next evening. It was about sunset when I suddenly observed him quite close, sitting under some bushes. He may have been there some time, invisible, until my eye 'realized' him. An inexperienced eye would never have seen him at all. He did not offer a fair shot and I waited for him to approach his kill which in due course he did. At such a time it is important to be careful not to make any motion to bring one's rifle into position unless the panther's eyes are turned away. On this occasion, I did unwisely move my rifle while he was standing facing me, though looking down at the kill, and the suddenness with which he raised his head and stared at my loophole indicated that my movement must have caught his eye. Then I did a stupid thing.

Rapidity of decision is essential to the making of a successful shikari, but it must be a decision based upon experience, not a mere acting upon one's first impulse which may be to do the wrong thing. My first and natural feeling on this occasion was that the beast had seen me and would bolt the next moment, and certainly, if he did so, his movements would be so rapid as probably to make a successful shot impossible. The natural impulse then was to shoot at once before he moved. This might have been quite all right, had his position been different. But the chance he offered was definitely not a satisfactory one—head on, facing me and looking up. There were two possible shots, one over his head into the spine rather far back, calling for absolute accuracy: the other at the upraised head, a shot which I knew perfectly well to be decidedly risky. On the other hand I had proved time and again that, provided you remain absolutely motionless, the chances are all in favour of a panther not detecting you behind a loophole, though he stare straight at it from a few yards' distance; that is, provided further, that the back of your *machán* is screened so that there is no open sky behind to give away the shape of your head, and that you do not risk causing the beast uneasiness by directly returning his gaze.

Well, on this occasion, I did not give the teachings of experience time to outweigh the force of the first momentary impulse. I knew it was risky, but I took the head shot and took it rather hurriedly. In the circumstances the tip of the nose was my point of aim but

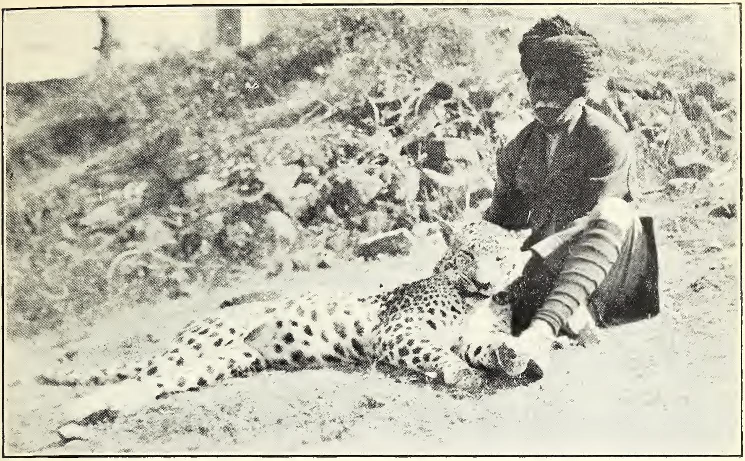
I raised my foresight a trifle too much, as in a hurried shot one is apt to do, and my bullet probably hit him too high and glanced off the sloping skull. I have dwelt at some length on a quite ordinary episode on account of the lessons it teaches—not to assume one is detected and act in haste because a beast stares straight at one, and to avoid, if possible, a frontal head shot.

One of the dangers of a head shot from the front lies in the risk of the bullet glancing off the sloping skull. Another rises out of the uncertainty of the subsequent course of a bullet which strikes the teeth or a jawbone. I may cite a case in point. A panther was sitting on a rock at dusk facing me at a distance of sixty yards or so, head and chest silhouetted against the sky. The light was failing and I found that I could not see my foresight against the panther's body but I could see it distinctly against the sky above. I, therefore, aimed just above him, then dropped my foresight with the intention of getting him in the chest. As it turned out I did not lower the foresight quite enough. At the shot the panther was knocked clean over and lay on his back with feet in the air. I thought I had him. After half a minute, however, he made two or three convulsive movements which took him to the edge of the rock over which he rolled to fall some twenty feet into some bushes below. It took perhaps ten minutes to descend and reach the spot where I expected to find him dead, but he was not there and blood marks showed that he had managed to reach the entrance of a cave a few yards away. That night we could do no more. Early next morning we were out exploring the rocks but failed to find him. Examining the original rock I found two whiskers on the spot where he had first fallen, indicating that he had been hit somewhere about the mouth. And that was that!

One of the best shots is that which aims to smash the shoulder. It may be broadside on through both shoulders, or obliquely from the rear behind the near one to smash the off shoulder. But the exact angle at which the beast is standing is important, for you want if possible to hit heart or lungs as well.

I lost a good panther once by shooting from his left rear too close to the near shoulder with the result that the bullet must have passed out in front of the far shoulder, without touching any vital part.

Another panther, in Kathiawar, which escaped after being hit in the shoulder, was an interesting beast. I was sitting on a sheltered rock overlooking the 'kill,' a goat, in the nullah below. The 'kill' was securely tied, by the neck, to a peg. It was a dark and windy night and, after dark, I had to rely entirely on my ears. After a time I imagined once or twice that I heard something resembling the sound of eating, but was not sure. At length I turned on my light and there was the panther on the 'kill'. The battery of my torch had run down a little and I think I rather misjudged his position and hit him somewhat farther forward than I had intended. At the shot he disappeared. On investigation I found quite a lot of blood on the spot, with a piece of bone an inch long, presumably from the shoulder. There was again nothing to do but leave him till the morning. But a very interesting feature



A Kathiawar Panther.

Vultures after a Meal.

was the condition of the goat. Now a large panther, when his 'kill' is a fairly big animal such as a young buffalo, will often start his meal at the root of the tail, otherwise he invariably commences at the stomach, continuing with the flesh off the ribs, and eating the whole of the body before touching the neck which he often leaves. In the present case the panther had eaten very little the previous day and that from the stomach. Now, to my surprise, I found that the stomach had not been touched, but that he had been working all round the neck, which was nearly cut through. He must have been at it for five or ten minutes before I turned on my light, none too soon. I see no reason to doubt the correctness of the obvious explanation that, when he found his kill fastened down by the neck, so that he could not drag it away, he deliberately set to work to cut off the head. The incident sheds an interesting light on the panther's intelligence. I have never heard of a similar case and one has always been inclined to look upon it as a sign of their lack of intelligence in some respects that neither tiger nor panther has ever been known, so far as I am aware, to cut with his teeth, as he could so easily do, the rope which often prevents him from dragging his kill away. The present case, however, certainly appears to indicate the exercise of something akin to definite reasoning. Later on I shall have a story to tell of a different kind of display of intelligence by a panther during a beat.

The morning's search resulted in putting up this panther, still full of life, three hundred yards away, and unfortunately he then managed on three legs to reach a cave near by. From this I found it quite impossible to evict him. Both this and the panther last named recovered from their wounds, both, however, permanently lame, which does not seem to have prevented them from continuing to obtain a livelihood.

While neither tiger nor panther will cut the rope which fastens his 'kill', he will pull until he breaks it by sheer strength if he can. And I have known a panther to carry a goat away, and on another occasion to remove a 'kill', in each case breaking the rope with which it was tied by the sheer force of his initial rush. If, therefore, one wishes to sit up over a 'kill', the strength of the rope is a factor not to be neglected. On the other hand, in the case more especially of a tiger, if you wish him to lie up in the neighbourhood with a view to a beat, you must allow him to drag his 'kill' away and, therefore, use a rope which he can easily break.

This matter of securely fastening a 'kill' is important. My subject is the panther, but I do not think I need apologise for introducing a tiger or two where the incident illustrates practice or principle applicable to the *shikar* of either animal. I once received *khabar* of a natural kill by a tigress among hills where a beat was out of the question, only in time to reach the spot shortly before sunset. There was no time to be lost and it only occurred to me after I had settled myself in the *machán* and my men were gone that the 'kill', a cow, had not been tied or pegged down. However, it was too late to mend matters: it was a secluded spot and the tigress might already be near by. To my left front was a ridge above which the full moon would appear at about 8.30 p.m.; if the tigress did not come before then I hoped that all would be well. At 7.45 I heard her voice, that short but distinctly impressive half yawning roar which is usually considered to be a call to a mate but which, in my experience, a tiger occasionally utters when contemplating a return to its 'kill', even though there be no other of its kind in the immediate neighbourhood. Half-an-hour later, the moon was up but had not risen above that intervening ridge when I heard her, two or three faint footfalls, and presently I realized that she was at the 'kill' and, what was more, was commencing to drag it away. I could vaguely make her out, a faint shadow : no sort of a shot, but in another minute or two she would be into the adjacent cover with her 'kill'. I had no torch at this time. There seemed nothing else for it, and I fired. A moment's silence and I heard her moving away, apparently quite leisurely, as if not seriously alarmed. And, to my surprise, this proved to be the case, for within ten minutes she was back again and once more pulling at the 'kill'. By now the moon was over the ridge and I could see her fairly well. Again I pulled trigger—a misfire ! The loud report of my *magnum* Paradox charge had not scared her, but the click of the hammer, the sound of metal on metal, was too much for her and she fled, not to return. Bad luck, wasn't it? A misfire with my Paradox is the rarest of events.

The luck was all on the side of this tigress. Another time it so happened that once again circumstances prevented my arriving at my *machán* until nearly sunset only to find that the *machán* prepared, not by own men but by the local State shikaris, was absolutely open at back and sides; they had only thought it necessary to put up a screen in front facing the 'kill' ! My tree and those round about were bare, there were no foliage trees or useful bushes near and there was no time to do anything. I did what I could with such branches as were available, but the retreat of the tigress was quite near and I had to chance it, though I knew I was probably wasting my time. It was at about 9 p.m. that I heard a blue bull give the alarm, to my left, and that was all. I spent the night out, having arranged to do so, and in the morning found the tracks of the tigress passing by thirty yards on the far side of the 'kill'. Following her backward tracks we came to a spot where she had sat down immediately after coming round a corner of the hill into sight of my *machán.* I sat down as she had done, sent a man up into the *machán,* and sure enough there was his head, not merely visible from where the tigress had sat, but conspicuous against the sky. There is nothing in the making of a *machán* that is more important to remember; from every possible point of view there must be an opaque background between your head and the sky.

I have said that I was surprised at this tigress, at our first meeting, returning to her kill after being fired at : this is a rare occurrence with a tiger; indeed, though I do not suppose my experience was unique, I do not remember hearing of a similar case. With the panther, a bolder animal, such a return is not uncommon. The sound of a shot in some jungles or their neighbourhood is not infrequent while, except in the case of an individual animal which has been wounded, it has not necessarily, it would appear, any definite association with human beings or with any particular danger. It is, therefore, a mistake to suppose that when a panther is fired at and missed, one must in consequence give up all hope of his return. The sudden loud report is alarming and puts a beast to flight, but the effect of the alarm is not lasting and whether he returns or not will probably depend upon his experience, his individual temperament and his hunger. I have known several instances, in the experience both of myself and of others, of a panther's return to a kill after being shot at. One or two of these may be worth recording.

My first experience of the kind, many years ago, was a surprising one. The panther in question was a female which the local *pagis* stated was always in the habit of returning late to its kill. When she killed a goat at a time when the moon was waning and not due to rise until 11p.m.—before the days of electric flashlights—I thought I would test the accuracy of this belief, so proceeded to take up my position just after moonrise. It was perhaps not surprising to find that the panther had, in fact, already returned and polished off the remains of her 'kill', but I thought it might be worth while tying up another goat and did so. I had not long to wait, for the receding flaming torches of the two men who had accompanied me were still in view, not more than two hundred yards away, when the panther killed. The moon had risen but was behind a cloud and I could see her but dimly. As, however, she began to try and drag her 'kill' away and I was doubtful about the rope, I risked a shot. Absolute silence; I thought I had killed her. But to my amazement, after a couple of minutes, I realized that she was again tugging at the goat. My shot, which had been a miss, at fifteen paces distance, had not caused her to move a foot from the spot! The cloud before the moon was moving aside, in another half minute I could see her clearly and my second shot was successful.

A more recent incident was interesting though this time it was the panther who scored. I was sitting over a goat at a spot where there was a chance of the panther offering a shot on the rocks above by daylight. In this neighbourhood hyaenas were numerous and would kill a tied-up goat. It was, therefore, the practice to tie a goat as bait on a platform, raised on poles five feet above the ground, inaccessible to a hyaena who is no leaper. This had been done in the present instance, necessary if it was desired to obtain a 'kill' beforehand, but probably a mistake when sitting over a live goat. However, I had never witnessed a panther's attack under these conditions, so I kept the goat on the platform.

Well, the panther did appear on the rocks before sunset and sat down on a boulder a hundred yards away, appearing at first sight to offer a fair shot. But when I put my glasses on him I found that a branch, projecting from a leafless tree in front of his chest and shoulder, was liable to intercept a bullet, so I decided not to risk the shot. This was item one in a series of lucky accidents destined to preserve this panther from harm at my hands. It was dusk, 7.30 p.m., when he slipped down from his rock out of my view and within ten or fifteen minutes I expected something to happen. But nothing occurred, though I waited for a full hour. Then I decided to turn on my light which showed him sitting on his haunches, facing me, some twenty-five yards away, just behind the goat's platform. How long he had been there, licking his lips and indulging in the pleasures of anticipation, I have no idea, but it is probable that, had the bait been on the ground, he would have attacked earlier. Well, the sudden glare of my flashlight caught him fair in the eyes. He stared and blinked, moved his head a trifle, clearly dazzled, and blinked again but gave no sign of being in the least perturbed. He could not have been in a better position from my point of view but for the fact that his chest was covered by one pole of the platform in front of him—again his luck was in! I hesitated, decided to go for the less satisfactory mark of his neck and fired. Bang! and he was gone. At the moment of aiming it struck me that there was something not quite right about my sights but stupidly did not pause to ascertain what it was. Too late I realized that the folding backsight of my Paradox had somehow fallen down, with the almost inevitable result that, aiming without a backsight, my bullet had gone too high—my enemy's third stroke of luck!

I knew I had made a clean miss, so it was possible the panther would return. But this might be a beast who knew what was meant by the report of a gun, wherefore it seemed advisable to try and bluff him into thinking I had departed. I whistled up my men, made them chatter around me for a minute or two and then go away talking—a stratagem that I have more than once adopted with success. The bluff came off; in about twenty minutes' time there was a rush and a momentary scuffle. I switched on my light and there was the panther sitting up on the platform facing me. Now the tree on which I sat grew out of a nullah from a lower level than the platform which, moreover, was placed on ground that sloped slightly upwards towards the rocks above. The result was that my loophole was little, if anything, higher than the surface of the goat's platform. It will be apparent that, in consequence, my eye being almost on a level with the edge of the platform, could see that edge and anything above it against the background beyond, but could not look down on the platform or, in fact, see anything of its surface. It was only after the event that I recognized the importance of this seemingly trivial detail which was to contribute to my final undoing.

When I turned on the light the panther was, as I have said, sitting up facing me, head and chest in silhouette against the background. Apparently all plain sailing this time. Since, however, the panther had had one shot fired at him from behind my light, I instinctively expected him to distrust a second turning on of light from the same spot and was therefore more in haste to shoot than I might otherwise have been. It was only afterwards that I realized that the panther's chest *had not shown up white* under the light as it should have done, for the simple reason that he was holding the goat as a shield in front of his chest, a fact which would probably not have escaped my notice had the surface of the platform immediately in front been within my sphere of vision. Result, my bullet cut the goat in two and the panther escaped once more!

The whole affair provided a striking illustration of how many a slip 'twixt cup and lip may occur in shikar. It further taught me the lesson that it is a mistake, when actually sitting up, to have a goat tied on a platform, both because it probably delays the attack and because it may, as in this case, cause one to form an incorrect idea of the position. It also confirmed me in the opinion, based on previous experience, that the majority of panthers are not alarmed by an electric flash-light; this agrees with the opinion of Colonel A. R. Burton, expressed in a recent number of this Journal. The practical conclusion is that there is no need to hurry over a shot at a panther in such circumstances: a tiger, like a hyaena, is more timid.

Of course, the average panther will always be put to flight, at any rate for the time being, by the sound of a shot at close quarters. At a little distance, however, he will, on occasion, take no notice, as the following account of a more successful evening will show. Three days after the last incident a pair of panthers were reported to be in a small, rocky hill which, with luck, might offer a chance on the rocks by daylight. I had a bush shelter constructed on a bank at the foot of the hill. Two loopholes in front commanded the whole side of the hill, of which the farthest point was not more than 150 yards distant. A third loophole on the right overlooked a tied-up goat. At the top of the hill to my left front was a kind of peephole in the rocks, caused by a big boulder stretched across the tops of two others making a sort of archway through which one could see the sky beyond.

I was in position over an hour before sunset. After twenty minutes or so I observed through the archway against the sky a dark projection which had not been there before. It moved and I identified the side of the head and ear of a panther, doubtless attracted by the calling of the goat. After five minutes he disappeared from view, possibly to approach the goat from the other side of the hill. To my right front, sixty or seventy yards away, was a small banyan tree, growing from the side of and above a flat rock. Part of this rock only was visible through a gap in the foliage at the top of a nearer tree. Suddenly through this gap, some fifteen or twenty minutes later, I caught sight of a panther standing on the rock I have mentioned and peering over its edge towards the goat below. Almost immediately it subsided on to the rock and lay down, head alone visible. I decided that if and when it sat up or stood again the shot would be worth taking, with my ·318 in preference to the Paradox. At first I supposed that this was the same beast that I had first seen through the archway above, but presently I realized it was not, as No. 1 appeared again and sat down on the near side of the archway—a long shot, so I waited in hope that No. 2 would give me a chance. For the best part of half-an-hour there was nothing but an occasional movement of the head as she studied the landscape, varied by a yawn or two. But at length she sat up, as if about to move, bringing chest and shoulder into view. This was good enough and I fired. At the shot she leaped about ten feet vertically into the air then rushed twenty yards downhill and collapsed.

I knew she was dead and turned to look for No. 1. Apart from the shot, his mate had spoken twice during her dying rush, not very loudly it is true, but I should have thought he must have heard her. However, a pile of rocks intervened; so he may not have done so. There could be no doubt as to his hearing the shot as there was nothing between him and me. But he had not turned a hair and was sitting, wearing a bored expression, in precisely the same postition as before. Head, neck and shoulder were visible, the distance 120 or 130 yards, but I could trust the rifle if I held straight, so aimed at his throat. At the shot he pitched forward; one or two convulsive movements and he lay still. Practically a right and left, except that I was using a magazine rifle, which fully made up for the mismanaged affair of three days before. The female was a big one, 6 ft. 4 in. between pegs, the male of moderate size, 6 ft. 7 in.

A panther returning to his kill is usually the personification of caution. I have seen one circle all round three or four times listening and peering intently in every direction. The instances I have already cited show how patient he can be before attacking a goat, and his approach is usually silence itself. But if he is hungry and unsuspicious he will at times be amazingly impetuous. I once sat up over a goat in a jungle at the foot of the Girnar Hill in Kathiawar. The goat was calling loudly and I had not been in position more than a few minutes when I heard the noise of some heavy animal plunging through the jungle. It might be an alarmed sambur but sounded more like a buffalo. Straight towards me came the creature, whatever it was, and, to my amazement, a large panther broke cover and pounced upon the goat.

On another occasion a panther was seen in the morning on some rocks close in front of which was an excellent tree in which I had a *machán* constructed. At 4 p.m. the panther was out on the rocks again and I succeeded in approaching behind the tree and climbing up unnoticed. Then I had a flock of goats driven past me and one of their number tied up as they halted beneath me. The panther immediately sat up and took notice. The flock passed on. Within five minutes the panther had slipped down and in five more was on the goat, at 4.30 on a hot May afternoon. I shall never forget the expression of the gleam in that beast's green eyes, as it sat up facing me, its fangs in its victim's throat—it was the acme of gloating ferocity, giving a remarkable impression of cruel joy in the act of killing.

The great *carnivora* kill for food and it is no doubt perfectly true that they do not ordinarily kill at one time more than will satisfy their needs. But there is equally no doubt in my mind that, given the opportunity, they will now and then slay for sheer lust of killing. I have known several cases of both tiger and panther making two and even three kills at a time and not attempting to dispose of more than one.

Another case of a panther turning out unusually early occurred in the Nilgiris. I had shot a sambur one evening and was only able to remove the head that night. The men sent out in the morning, to bring in the skin and meat, came back with the news that a large panther had been at the body, so I determined to try for him in the afternoon. The sambur lay on the open hillside, about thirty yards from the edge of a thick and extensive cover. The panther might be anywhere near, so it did not seem advisable to try and put up a *machán,* and I decided just to go out and try and arrive unobserved at a small ridge behind which I might lie within easy range. As the sambur was in the open the chances seemed against the panther coming out early and I thought we should be in good time reaching the spot at 4.30 p.m. But it was not to be. As we reached the top of a rise in sight of the kill 200 yards away we saw the panther on the 'kill'—a real big beast. But he saw us at the same moment and at once retired to cover. He might be watching near by and I saw no likelihood of reaching the ridge I have mentioned unobserved. I had to be content with getting safely to a hillock, perhaps 120 yards from the 'kill', which should be near enough if he returned in daylight. To cut the story short, he emerged from the cover as the light was failing and strolled leisurely up to the 'kill'. He was a magnificent beast, beyond question the biggest I have ever seen; he looked like a tigress—the eight foot panther of one's dreams! But alas, as he halted in the shadow of the hill side, I could hardly see my foresight: it was not good enough. But such a panther! I could not resist temptation and fired. My bullet was obviously just too high and he was gone.

There was nothing unusual in that Nilgiri panther dining off a sambur which he had not killed himself. The panther is an extremely efficient hunter, but, like the lion in Africa, he has no hesitation in partaking of a ready-made meal. I met with an interesting instance of this in the little State of Vijayanagar. I was sitting one evening over the kill of a tigress. My *machán* was in a tree in a nullah, the banks of the nullah to my right and left front were almost as high as the level of my eye, so the position was not a good one, but the best available. A little before sunset I suddenly observed a large panther sitting on his haunches on the left bank, looking down at the 'kill'. I was not prepared for sitting up after dark and thought my chances of getting the tigress in the circumstances were small, while the panther was a fine specimen; so I took the shot, an easy one, only to make one of those inexplicable misses that will occur now and again to every shikari. One likes to assume they are due to faulty cartridges, and no doubt they sometimes are, but not always! I had not much hope of anything after that, but decided to sit on until dark. Presently a mongoose appeared, one of the dark grey species with black tip to his tail which is not uncommon in these hills, and after some hesitation settled down to a meal. The sun set and the light was beginning to fail when, from beneath my *machán,* came the sound of a stone turned over by some passing foot. I looked down and there was another panther, a good male but, I thought, definitely smaller than the first, creeping stealthily forwards towards the kill. The mongoose saw him too and gave his peculiar little alarm cry. I expected him at once to turn tail, as I have seen them do on other similar occasions. But, to my amazement, he sat up on a stone and proceeded to hurl abuse at the panther who took not the smallest notice but continued a slow stealthy approach.

No doubt the mongoose considered himself entitled to his perquisites from any 'kill' pending the arrival of the rightful owner to whom he could not object to give way. But he did strongly object to trespassing by a beast who was well able to kill big game for himself. And so the little thief sat there, pouring out upon the head of the big thief the vials of his wrath in purest Billingsgate. It was fascinating to watch the little beggar's audacity; the panther was now within six feet of him. I wished afterwards that I had waited to see the end of the little drama. But the light was going and the shot offered was just what I wanted; so the bigger thief paid the penalty for his meditated crime. Subsequent investigation of tracks showed that this was, as I had thought, a different panther and that the first had got away unscathed.

The mongoose, of two species—the common kind and the larger darker one with a black tip to his tail—is a frequent visitor to a 'kill'. Sometimes there may be a party of two or three, when their bickerings over a carcase are amusing to watch. They are usually very nervous and on the alert and their peculiar alarm call and hurried departure will often give the first warning of the approach of tiger or panther. Once a big mongoose was busy on a tiger's 'kill' when a grey jungle fowl came up pecking about on the ground. At one time she was within two feet of the mongoose but took no notice of him whatever, nor he of her, although the mongoose is a deadly foe of poultry. It was an interesting illustration of the fact, which has often been noted, that the denizens of the wild, whether by means of telepathy or some form of instinct, appear to possess a faculty of divining an absence of hostile intent on the part of a hereditary enemy, and in such cases will show no fear of him.

Other visitors to a 'kill' are hyaenas and jackals, the latter always very nervous. I once heard of a case of a porcupine making a hearty meal inside a dead buffalo. Of birds, the tree pie sometimes joins in the feast and I have known a myna to do so. Then of course there are the vultures and crows and occasionally an eagle of plebeian tastes. I have seen a jackal watch a concourse of vultures in the air, collecting over a kill, and take them as guides to the spot. The celerity with which vultures will dispose of a dead animal must be seen to be realized; it is a gruesome sight. After the pair of panthers mentioned above had been skinned and thrown out the two skeletons were picked clean in fifteen minutes.

I have never seen the *chaus*—the common jungle cat—on carrion. But I have seen one, and another time the grey spotted desert cat, take great interest in a tied-up goat. I do not think I know of any expression more coldly cruel than that of the pale green eyes of the jungle cat. It was when sitting over a goat in the Danta State that I once, at dusk, observed a specimen of that rarely seen animal, the ratel or honey-badger, stroll past within a few yards.

Sitting up, like any other form of shikar, is greatly affected by the element of luck. But, as I have tried to show, many a failure which is ascribed to bad luck is in reality due to neglect of proper precautions, bad *bandobast* or lack of jungle craft. And good luck may at times bring success that is undeserved. Like others I have had my share of both. The following tiger story is as good an instance as I know of real undiluted bad luck.

The 'kill' was a three year old buffalo of which little had been eaten. The *machán* was a good one in a tree at the foot of a hill to which the tiger had retired. The month was May and the ground in places was thinly carpeted with dry leaves, which have their uses when a lightly treading feline is about. I was in position shortly after 5 p.m. with more than two hours to go before sunset. Nothing happened for an hour or so, then suddenly, from quite close by, sounded the *Baa, Baa* ! of an unfortunate goat, presumably strayed from some flock that had been grazing in the neighbourhood earlier in the day but long since departed. This was disconcerting; I fully realized that the creature's presence might mean the upsetting of my apple cart! But I had climbed into my *machán* by means of a ladder, which I had thought advisable to have removed. I might scramble down but to climb up again was impossible. Of course, I could call up my men, and this I should not have hesitated to do had a panther been in question. But a tiger was another matter. It was but an hour to sunset and he might already be close by. There was nothing to be done but sit tight and trust that the unwelcome goat would wander away.

Time passed on, the shadows lengthened on the hillside, the sun went down. It was, however, still daylight when from, I judged, some two hundred yards up the hillside, there sounded the sudden sharp alarm call of a keen-eyed peafowl. The tiger was afoot. Daylight faded into dusk. Dusk gave place to the dark of an Indian starlit night, not so dark but what the 'kill' was still vaguely visible to straining eyes as a black blotch on the ground, but too dark for it to be possible to distinguish a tiger's coat. That mattered little, for my faithful flashlight was to hand. It was about eight o'clock when I heard the first faint footfall on those dry leaves to my right. Presently again to my left. Once more, this time behind, then nearer—undoubtedly the tiger, and he was clearly, having finished his reconnaissance, moving forward to his kill. Shikar in the light of day can furnish thrills many and varied, but none of quite the same quality as that with which one first realizes the immediate silent presence of a great beast of prey in the darkness of night. I think I have said something like that before!

Baa ! Out of the darkness came the cry, timed by some impish spirit of the jungle with the most amazing exactitude; plaintive, incongruous, exasperating to the last degree. . . . What would *you* have said? But no mere words could be adequate! For about two minutes, dead silence; I did not hear the tiger move; then a slight momentary scuffle and a strangled cry, perhaps thirty yards to my right: the unfortunate instrument of fate had fulfilled the final purpose of its existence. Within a minute or so I heard the tiger drag the prey for a short distance past the back of my *machán* and then, within hearing, he proceeded to dine, to the accompaniment, for a while, of a volley of abuse from a langur who had been aroused from his sleep in a tree near by. I still hoped against hope that goat mutton would but serve the purpose of *a hors d'oeuvre* before the main course of buffalo beef. But it was not to be. By the time he had polished off the whole goat that tiger considered he had dined and departed elsewhere.

It was distinctly bad luck, for me, on another occasion when the occurrence of a tiger's kill, in favourable conditions for sitting up but not for a beat, found me possessed by an appalling cold in the head with a cough accompaniment! It was obviously futile to attempt to sit up for a tiger with a certainty of meeting his approach with a chorus of alternate sneezing and coughing. Fortunately for himself a friend was within reach to whom I supplied my Paradox and electric torch and sent him out, to return by 9.30 p.m. in triumph with his first tiger.

In connection with the precautions to be taken when sitting up I have not mentioned, because I do not think it necessary, one which is sometimes advocated—the avoidance of smoking. It is not impossible that wild beasts, when they detect it, may associate the odour of tobacco with the presence of human beings. But all Indian big game hunters are agreed that the power of scent in the great cats is but feeble. I habitually smoke a cheroot in a *machán* in a tree above the level of the nose of a beast on the ground, merely taking care that there is no possibility of its glowing end being visible in the darkness. In a hide on the ground it may be wiser to abstain though when, as experience has proved, a panther prowling all round one within a few yards will fail to detect the human scent, it is doubtful whether he would detect the odour of tobacco.

The scent of tobacco is, however, perhaps stronger and more penetrating and may have been the cause of failure on one occasion when I found the remains of at least a dozen *bidis* (native cigarettes) around my *machán* on arrival. The men who had put up the *machán* had apparently, after finishing their work, sat for an hour or two under the *machán* talking and smoking—a good example of how not to do it.

The kill on this occasion was the work of two tigers whom I heard calling to each other about dusk. The spot was close to water and it may have been a sambur coming to drink that I heard bell close by a couple of hours later. But I have since wondered whether this may not have been a case of the much discussed 'sambur' call of the tiger. The morning's tracks showed that one tiger had been within twenty yards of me.

To return to the panther. His sawing note is usually, I think, though perhaps not invariably, a call to a companion. His growl of menace is familiar but a pair together sometimes give vent to weird sounds that are not easy to describe. Once, on the borders of the Gir, I heard a dying panther give vent to a roar of surprising volume. There was no mistake as to whence the sound came, otherwise I should have put the roar down to one of a party of lions which I had heard, not far away, half-an-hour before, and which actually killed a buffalo only a quarter of a mile away from me while I was waiting for the panther. I heard the hubbub as they were driven off by a crowd of villagers but did not at the time know what had happened, or I should have tried to be in wait to see something of them, not to shoot—the lions of the Gir are strictly protected, a fact which has led to a considerable increase in their numbers of recent years.

I have referred to instances of a panther breaking a rope and carrying off a goat with his initial rush and I have known of one dragging a good sized donkey fully three hundred yards over rough and hilly ground. But the most remarkable display of sheer strength by a panther which I have come across was that of one—from his pugs a not particularly large male—which killed a big cow, a fine specimen in good condition, of the large Kankrej breed. The point of interest lay, not in the mere killing of the cow, but in the fact that, seized by the throat as she lay, she was so firmly pinned down that she was absolutely unable to move, as evidenced by the fact that she was found dead in the ordinary recumbent position of a cow at rest chewing the cud; there were no signs of a struggle and no wounds beyond the usual fang punctures in the throat; the panther had been disturbed before he had commenced his meal.

I do not think I have anything more to say about sitting up in India. But I had two remarkable experiences in Somaliland which were recorded in *My Somali Book,* published in 1913. As that work is now out of print I may perhaps be permitted to conclude this chapter by giving the substance of a couple of extracts therefrom.

The first instance afforded perhaps the most striking example in my experience of the combination of audacity with wariness which is so characteristic of the panther. Not very far from my own camp on one occasion was a *karia* or temporary village of nomad Somalis, who, according to their custom, used at night to pen their flocks of goats and sheep inside a thorn *zariba* for protection against wild beasts. A hungry panther, however, makes light of a five foot thorn fence, and one had quartered himself on this *karia* and levied toll of mutton therefrom three or four nights a week. My assistance was asked against the enemy; so I visited the *zariba* one evening and took up my position sitting behind a loophole in the thorn fence with a goat tied up outside a few feet away. This was rather a different game from sitting up in India, in that the panther was fully aware of the presence of human beings behind the fencing and was in the habit of trying to steal a meal from under their very noses. It was a clear starlight night, but no moon. Not long after dark I became aware, from the uneasiness of the animals in the *zariba,* that the panther was about, and eventually discovered that he was standing outside the fence within six feet of me watching my goat, but not within sight of my loophole. Whatever his reasons, he decided to let that goat severely alone, and presently moved round to the far side of the *zariba,* as appeared from a stampede of frightened sheep who scented him there. Nothing happened and I fell asleep beside my loophole to awake after a while to find a quarter moon shining. Suddenly I heard a commotion on the other side and, the next moment, saw a shadowy form race across the *zariba* and clear the fence a spear's length from where I lay : it was the panther, and he had taken a sheep with him ! I could almost believe I heard a mocking laugh as he disappeared in the darkness; the whole proceeding seemed to involve, in its preliminary caution and its ultimate audacity and brilliant execution, a deliberate accurate calculation of risks which was beyond all praise.

It was night-watching from a Somali *zariba* that led to another exciting moment. I pitched camp one evening in a small open space amid jungle, and, as fresh tracks of panthers had been seen near by, had a goat tied up at dusk outside the usual loophole in my *zariba* fence, and sat down to dinner at my tent door. As there was always a risk of the goat being attacked by a hyaena I put one of my shikaris on guard at the loophole until I was ready.

I had but got through my soup when there was a sudden loud growl and then a succession of angry roars. I ran out, to learn from the shikari that some beast had unexpectedly rushed and killed the goat, that in the dark he had mistaken it for a hyaena and jabbed it with a spear, with the result that I had heard. The manifestations of wrath had been so loud that he thought it must have been a lion, and that there were two or more. Dinner was forgotten, as I squatted down by the loophole to watch over the kill lying about four feet in front of me. Nor had I long to wait, for within three minutes the enemy was back on the 'kill' and, the next moment, a round face with blazing eyes and wicked snarl appeared in the loophole itself, the while, to the accompaniment of a thunderous growling roar, my gun-barrel—doubtless taken for the spear he had felt before—was seized by an aggressive paw and dashed to one side ! My finger was on the trigger and, naturally, the gun went off, the bullet passing somewhere by the beast's ear. This was a little too much for him and he retired. But it was not five minutes before he was stealthily creeping up to the kill once more, straight in front. At my shot he sprang with a growl to one side where I could no longer see him, but could hear that he seemed disabled and unable to get right away. Presently, mingled with his moans, came other sounds, from which it appeared that he had been joined by, presumably, his mate who, with friendly scratchings, was trying to cheer him up and persuade him to come away out of danger ! Then, as I was listening with all my ears and peering into the darkness, my eye suddenly caught a movement on the other side and, glancing round, I beheld another shadowy form near the kill. I fired, and the newcomer leapt into the air and fell beside the kill, motionless. I turned on my little electric torch, and there lay a beautiful panther, the most cleanly spotted that I have ever seen.

Assured that this one was dead, I decided to risk going out with a lantern, and we found that the sound of the last shot had evidently inspired the first wounded animal to renewed efforts and he had managed to drag himself into the bush a few yards away. To go after him in the dark would have been sheer folly and I had to content myself with moving the dead panther inside the *zariba* and then lying down to wait for the light of day. Before long, however, there rose an ominous sound, reminding one somewhat of a steam syren, the weird gathering call of the *warába*—the big spotted hyaena—who had scented blood. And we soon realized that there were several of the foul brood assembled around the dying panther whose menacing growls, though growing fainter, still kept them at bay. I feared for my trophy, and with cause, for when dawn came our investigations could discover but the tufted tip of a tail and a partly gnawed head—sole remains of what, from the size of the skull, must have been a magnificent panther. The empty stomach of the other, a male of average size, showed that game must have been scarce and that hunger was the explanation of the audacious determination of these panthers not to be deprived of their kill.

In a concluding chapter I hope to give an account of a few daytime experiences with the panther.

(*To be continued*)

ABNORMAL TUSKS OF ELEPHANTS

BY

SIR FRANK COLYER, K.B.E., F.R.C.S.

(With 6 plates)

The six small tusks shown in fig. 1, were removed from the 'tuskless' side of a rogue elephant. There was a seventh tusk which it was impossible to extract owing to it being firmly embedded in the bone. They were obtained and presented to the Society by Mr. C. R. Pawsey, I. C. S., Deputy Commissioner, Mokokchung, Naga Hills, Assam. The specimens have been presented to the Royal College of Surgeons' Museum by the Bombay Natural History Society. In the letter accompanying the gift it was stated that 'the tusks were jammed together and between them a substance described as being like marrow was found. The tusks protruded a distance of 2 or 3 inches from the opening of the socket.' The length and girth of the tusks are as follows:—

Tusk	1	length	61 cm.	girth	19 cm.
,,	2	,,	56 ,,	,,	15·3 cm.
,,	3	,,	42 ,,	,,	12·7 ,,
,,	4	,,	42 ,,	,,	7 cm.
,,	5	,,	28 ,,	,,	7·3 cm.
,,	6	,,	26 ,,	,,	7·6 cm.

Sections made through four of the tusks show that they are composed of well formed ivory surrounded by a layer of cement.

The probable positions of the tusks to one another are shown in fig. 2.

Cases of multiple tusks are rare and there are but few records in the literature of pathological ivory. There is a reference in Chapman's 'Travels in Interior of South Africa' to a male elephant with nine perfect tusks; the tusks were ranged five on one side and four on the other. There is also a specimen in the Royal College of Surgeons' Museum where the tusk is represented by eight 'tusklets' (fig. 3). The tusks vary in length from 37 cm. to 23 cm. and were to some degree functional as shown by the wear of the tissues.

I propose in this paper to discuss briefly the possible causes of multiple tusks by describing a few specimens which shed light on their etiology.

The specimen, fig. 4, seems to show that the double tusk is at times due to dichotomy (division in two parts) of the tooth germ; in this tusk there are definite grooves on opposite sides of the tusk. Amongst the Hunterian specimens there is a mutilated cranium of a young elephant in which the left tooth is just protruding from the socket, it is indented longitudinally at the base above and below, so that if it had continued to grow, it would have resembled the tusk shown in fig. 4. The right tusk has been lost but there is evidence that it was similar in type to the left tooth.

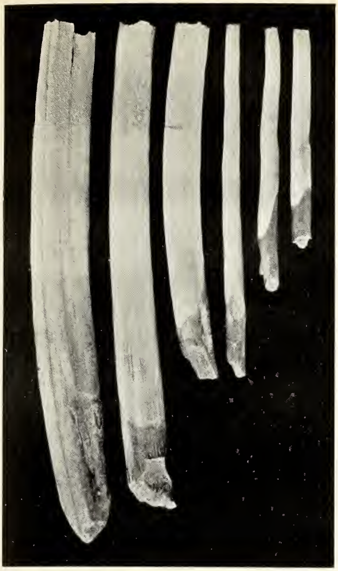


Fig. 1. Six tusks from the same side of a "rogue" elephant.

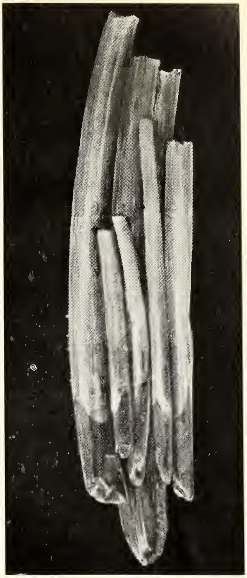


Fig. 2. The relations of the tusks (fig. 1) to one another.

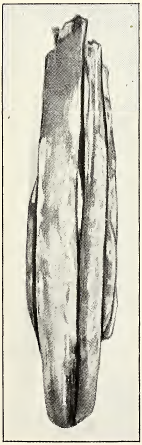


Fig. 3. A specimen made up of eight small tusks.

(Royal College of Surgeons, Odontological Series G132.2.)

From the *Dental Record.*

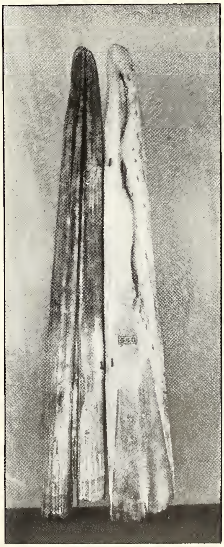


Fig. 4. A specimen showing a stage in the production of a double tusk.

(Royal College of Surgeons, Teratological Series 540.)

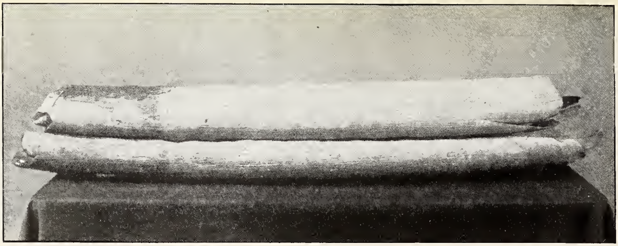


Fig. 5. An example of a double tusk.
(Royal College of Surgeons, Odontological Series G120.01.)

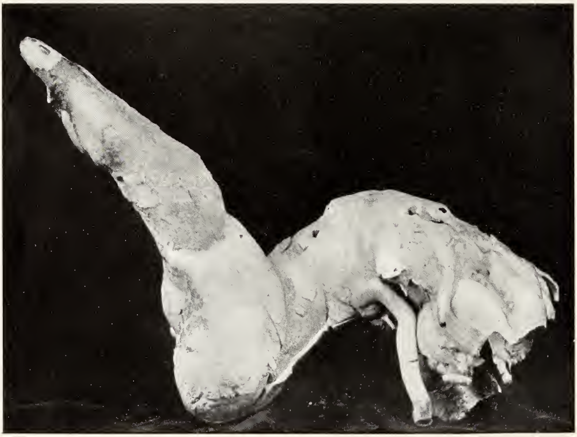


Fig. 6. A tusk which has been injured at an early stage of growth.
(Royal College of Surgeons, Odontological Series G120.2.)

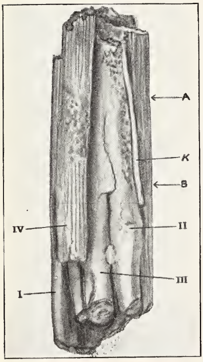


Fig. 7. Portion of a tusk which has been injured.
(Royal College of Surgeons, Odontological Series G122.4.)

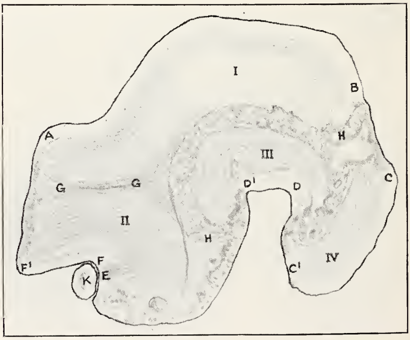


Fig. 8. Section, at the position A, of the tusk shown in fig. 7.

The tusk, fig. 5, is another example of a double tusk. The two portions are unequal in size, and where the surfaces are in contact, each portion is somewhat S-shaped. The foregoing specimens would seem to be examples of dichotomy. There are however cases of double tusks which seem to arise from the development of an accessory tooth germ such as we see in the extra incisor at times met with in man and other animals. An example of a double tusk, which probably originated in this way, was brought to my notice by a big game hunter in East Africa. One tusk weighed 27 lbs. and was twisted so that it curved downwards and backwards bringing the point between the elephant's knees. At the base of this tusk was another small tusk, the end of which had been broken. A piece of the surrounding bone was present and one was thus able to obtain an accurate idea of the relation of the one tusk to the other.

There is fairly good evidence that cases of four-tusked elephants occur—that is to say there are two tusks on either side. During the month of January 1926 there were several letters published in the *Times* on the question of four-tusked elephants from the region of the Congo-Divide. One writer, Capt. Tracy Phillipps, stated that he stayed a night at the residence of the Vongara-Zande Sultan Ngilima, who described how he had killed a ' four-tusker ' during the war. In one letter reference was made to an elephant with four tusks seen by an army officer in the region of the Congo-Divide. The account published in *Sudan Notes and Records* (Vol. II, 1919, p. 231) is as follows :—

' On May 18, 1917, I was out shooting in the district of Sheik Ako Mangara, in the Markaz of Yambio, in the village of Wakila Marbo, on the borders between Tembura and Yambio districts. I met a herd of elephants, which I followed, searching for a good one to shoot. I kept following them until they stopped near a pool of water, where they began to drink and throw mud on themselves. I was hiding behind a tree about 15 yards from them, looking at them, when I saw an elephant with four tusks. The left tusk was the bigger and had the usual direction, but the direction of the small tusk was downwards and came out from under the big one. It was round, and its thickness was about 2½ in. The direction of the right tusk was downwards, and the small tusk came from under it in the usual direction, but it was small, like the other one.'

It is of interest to note that the natives of the district do not question the existence of four-tusked elephants. Capt. Tracy Phillipps makes the suggestion ' that the four-tuskers ' of the Uele-Shari may be rarely recurrent types, and something more than mere accidental freaks of Nature. The fact that the condition described was symmetrical is in favour of a developmental origin and it is more probable that the extra teeth arose from accessory tooth germs than by dichotomy of one tooth germ, as in the latter case one would expect to find the teeth on each side simulating one another.

Many cases of multiple tusks are, I feel sure, due to trauma, i.e. produced by injury, and the following specimens show the manner in which the tusks may be formed. In fig. 6, is shown a tusk which was injured at an early period of growth. The tusk is normal in shape for the first 3 cm. ; then it gradually increases in thickness for a distance of about 40 cm. It next takes a course at a right angle for about 12 cm., still increasing in width, and is then bent abruptly downwards. A longitudinal section shows that the formed part of the tusk was dislocated at almost right angles on the soft dental papilla. A feature of the specimen is the splitting off from the main portion of the tusk of 'branch-roots.'

The specimen, fig. 7, shows a stage in the formation of subsidiary tusks. The free end of the tusk has been broken in a transverse direction subsequent to the initial injury. For convenience of description the tusk may be divided into five portions, I, II, III, IV and K, fused together at the upper end, but separated at the lower or growing end, the portion K for the greater part of its length forming a distinct tusk. The relations of these portions, the one to the other, are shown in the diagrammatic views of sections made 12·5 cm. (A) and 30 cm. (B) from the broken end. The arrangement of the tissues at the position (A) is seen in the drawing fig. 8. Starting from the top left-hand corner and moving to the right there is a regular layer of cement until (B) is reached ; here for 2 cm. the tissue is of an indifferent type ; then follows, at (C), a layer of regular cement, which continues until the upturn of the indent at (C′), where there is a short break. A regular layer of cement forms the roof of the indentation and from here the outer layer as far as (E) is tissue of an indifferent type ; from (F) to (F′) there is a layer of cement, and from (F′) to (A) indifferent tissue, on the inner aspect of the cement layers there are areas of well-formed ivory, which for convenience of description are numbered I, II, III and IV. These areas are separated the one from the other. Between the areas I and II there is a layer of tissue dark in colour (G); the area I is separated from the area III, and area III is divided off from II and IV by a wide layer of secondary dentine, (H). K is a section through the detached tusk. The arrangement of the tissues at the position (B, fig. 7) are shown in the diagram, fig. 9. It will be noticed that the tusk is, in this part, composed of well-formed ivory, and there is very little secondary dentine. The areas I, II, III and IV, somewhat ill-defined in section (A), are now well-defined. Area IV is separated completely from the main part of the tusk ; there is a slight fissure between the areas I and II, and area III is almost separated from the rest of the tusk. As the terminal part of the tusk is approached, these four areas become completely isolated the one from the other as shown in fig. 7. If the animal had lived, these four areas with the small tusk would have continued to grow as separate units and in time would have passed out of the socket. An injury at this stage breaking the tusk in a transverse direction near the neck of the tooth would leave five tusks.

The specimen, fig. 10-(I), is another example of the formation of subsidiary tusks as the result of injury. There is a main tusk (A) about 58 cm. long and attached to this are two smaller tusks (B and C), which are placed in an oblique across the main tusk. The elephant had received a severe injury which broke the tusk, splintering it in a longitudinal direction. Recovery followed and then, at a later

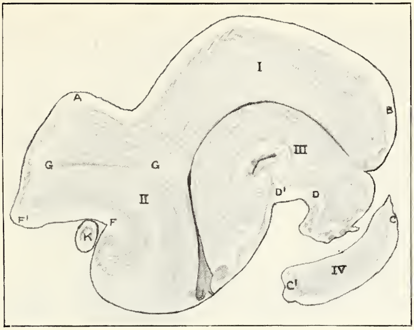

I
A
B
G
G
III
II
D'
D
F'
F
K
C
IV
C'

Fig. 9. Section, at the position B, of the tusk shown in fig. 7.

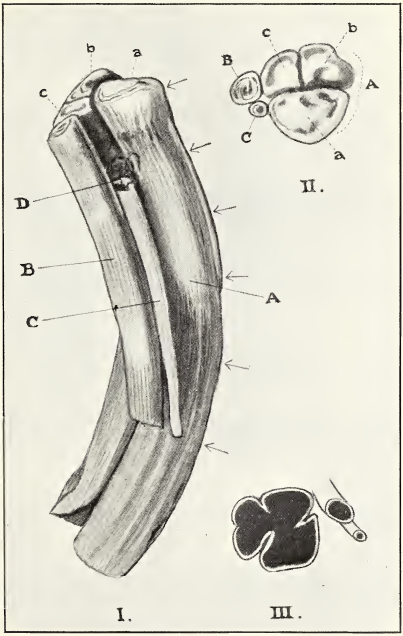

b
a
c
D
B
A
C
I.
c
b
B
A
C
a
II.
III.

Fig. 10. A tusk which has been injured.
I. General view of the tusk.
II. View of the free end.
III. View of the growing end.
(Royal College of Surgeons, Odontological Series G132.2.)

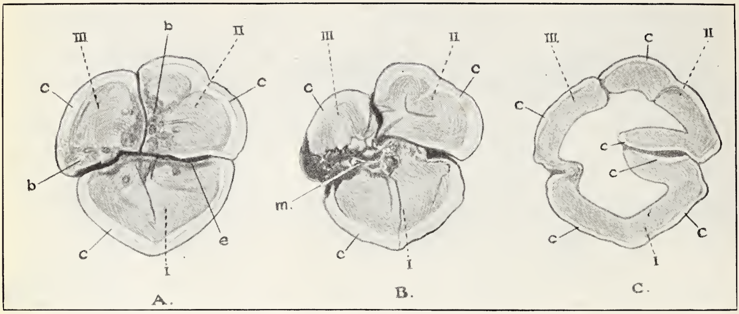

III
b
II
c
c
b
c
e
i
A.
III
II
c
c
m.
c
i
B.
III.
c
II
c
c
c
c
c
i
C.

Fig. 11. Diagram of the arrangements of the tissues of the tusk shown in fig. 10.

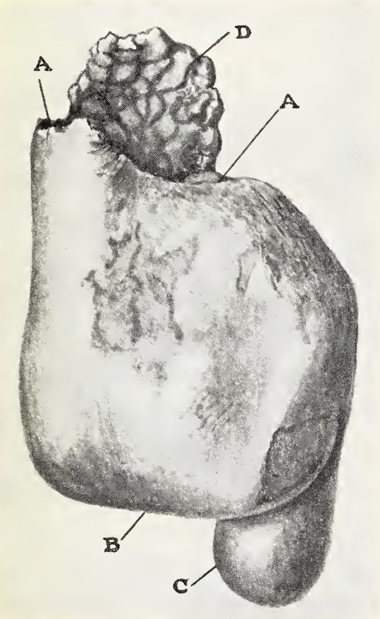


Fig. 12. A tusk removed from the tuskless side of an elephant.

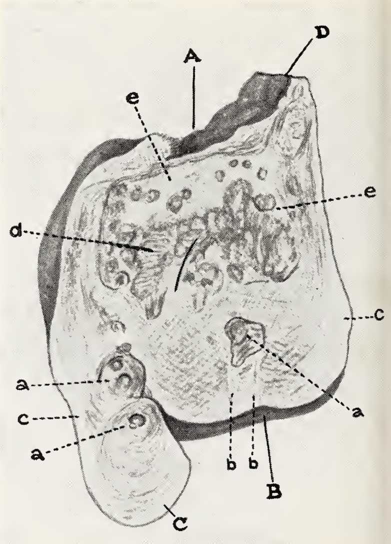

D
A
e
e
d
c
a
c
a
a
b
b
B
C

Fig. 13. Section through the tusk shown in fig. 12.

date, the animal was hit by a bullet which entered the tusk at the position (D) and in its passage broke off a portion of the tusk (C). The end of the main tusk is split into three segments as shown in fig. 10–(II). To ascertain the structure of the tusk six sections were made at the positions indicated by the arrows. A diagrammatic view of the relations of the tissues in the first section is shown in fig. 11–(A). Each segment, on the outer side, is covered with a layer of cement (c). The main part of each segment is formed of ivory, the dentinal tubes radiating towards the centre of the sections (I) and (III) and in the case of section (II) towards two centres. This arrangement suggests that the pulp was split into three main parts the ivory forming on the surface of each part. The portion of the segment (I) facing the fissure is composed of a tissue (e) which has the appearance of a poorly calcified cement. The portion of the segment (II) facing segment (I) is formed in the outer two-thirds of a layer of cement and the inner third of an irregular layer of secondary dentine (b) which is also the type of tissue forming the border separating this segment from segment (III). A layer of secondary dentine forms the border of segment (III) facing segment (I).

The second cut through the tusk was made about 10 cm. from the end and has the appearance shown in the diagram fig. 11–B. This section which passes through the portion of the tusk injured by the bullet (m) shows that the missile in its passage shattered the ivory. The ivory in the segments is better formed than in the first section and the arrangement of the dentinal tubes around the segments of the pulp is clearly shown in the segment (II). The sections 3, 4 and 5 show progressive stages towards the formation of ivory normal in type and the replacement of the outer layer of the secondary dentine by cement. The segments (I and III) become united, the segment (II) remaining detached as shown in fig. 11–C which is a diagrammatic view of section 6.

The formation of subsidiary tusks as the result of injury is probably brought about as follows :—The injury disorganizes the pulp or formative part of the tooth and the pericementum dips into the pulp and in this way separates a portion or portions from the main body. The fold gradually extends around the portion thus separated, so as to envelop it completely. In the opinion of W. D. Miller (Dental Cosmos, Vol. xxxii, p. 507) it is a question whether ' this fold of pericementum in dipping into the pulp carries a layer of odontoblasts along with it, or whether the odontoblasts are subsequently formed '.

A suggestion has been made that elephants with only one tusk carry on the tuskless side rudiments of a tusk, that is to say, the tooth fails to develop in a normal way. In *the Field* May 10, 1928, R. C. Morris gave an account of a ' rogue ' elephant in which there was on one side a well-formed tusk, and on the other side buried in the bone of block of ivory. He also records a similar case in an animal shot by Major Brook Purdon. The deformed tusk removed from the animal shot by R. C. Morris is shown in fig. 12. The tusk measures 34 cm. in its greatest circumference. The upper surface (A) is irregular in formation, two-thirds of the lower surface is smooth and globular in outline (B), the remaining third forms a projection (C) which appears as bent towards the part (B).

A section made in a longitudinal direction shows the tissues arranged as shown in the diagram, fig. 13. The lower half of the tusk is of a fairly regular formation; the portion (B) is formed of normal dentine with a small area of secondary dentine (a) near the centre; running down from this secondary dentine are two white streaks of tissue (b); on the outer side of the dentine there is a layer of cement (c); the portion (C) is formed dentine somewhat laminated in character which curves round two islands of secondary dentine (a): on the outer aspect there is a layer of cement (c). The upper boundary of the normal dentine, indented by small masses of secondary dentine which increase towards the upper border.

Intermingled with this secondary dentine are fragments of normal dentine (d) which are obviously the result of injury. Beyond this area there is a layer of dense tissue (e) through which are scattered islands of secondary dentine. The two layers, viz., the layer of secondary dentine and the hard tissue form on section a quadrilateral area, which is bounded on the lateral surfaces by tissue laminated in character, this tissue being a prolongation upwards of the dentine forming the lower portion of the tusk.

On one side (the left in the illustration) this laminated tissue bends over and is continued as a layer to form the upper boundary of the tusk, and is separated from the prolongation on the right side by an oval-shaped mass of secondary dentine also surrounded by laminated tissue. The arrangement of the tissues as they appear in the section is strongly suggestive of injury to the growing tooth. An examination of similar masses removed from the tuskless side of this type of elephant would help to clear up the cause of the condition.

The formation of subsidiary tusks when due to injury would seem to follow a blow which causes the tusk to split in a longitudinal direction. In some of the cases in which the tusk is split in a longitudinal manner necrosis of some of the fragments follows, and a single portion of the tusk retains sufficient vitality to recover.

The two specimens, figs. 14 and 15, illustrate these phases in the life of injured tusks. The one shown in fig. 14 was removed from an elephant shot by the Game Ranger 'in defence of crops.' It is 60 cm. in length. For purposes of description the tusk may be divided into two portions. The portion (A) is circular in shape, and is traversed by a deep furrow which is continuous with the concavity in the portion (B), the latter is scoop-shaped and gradually diminishes in thickness towards the growing end. To ascertain the nature of the tusk, sections were made at the positions I and II. A diagram of the section of the tusk at the position (I) is shown in fig. 16. The part (A) is composed of ivory with the typical criss-cross pattern, the outer surface of the ivory being covered with a layer of cement (c). The part (B) shows an interesting state of affairs. There is an irregular shaped area of ivory (i) which is surrounded by tissues of varying character and density. To the right hand of the ivory there is an area (d) which appears to be homogeneous in structure, the lower surface is bordered by a narrow layer of tissue

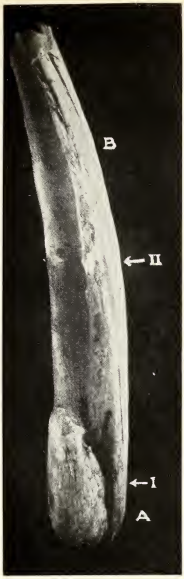


Fig. 14. A deformed tusk.

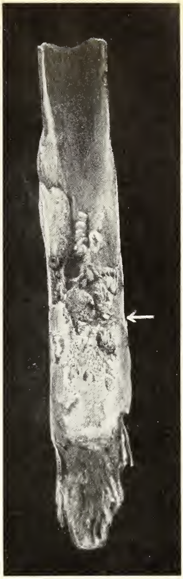


Fig. 15. A deformed tusk.

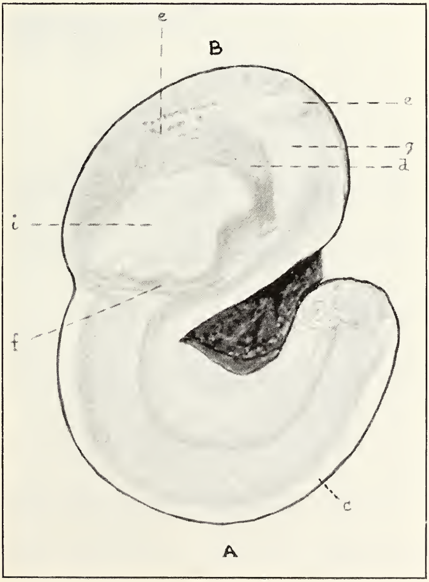


Fig. 16. Section through the tusk shown in fig. 14 at the position marked I.

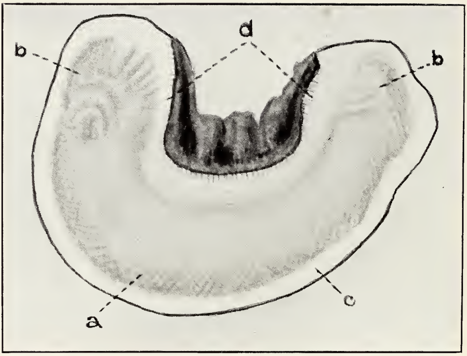


Fig. 17. Section through the tusk shown in fig. 14 at the position marked II.

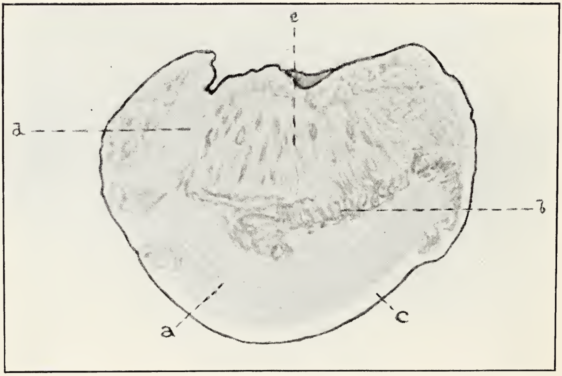


Fig. 18. Section through the tusk shown in fig. 15 at the position marked in the illustration.

laminated in type (f), this extends upwards on the left of the ivory to blend with an area of secondary dentine (e). To the right of the area (d), there is a triangular shaped mass of tissue (g) which has the appearance of ivory while beyond this there is a secondary dentine (e).

A section through the portion (B) has the tissues arranged as shown in fig. 17. The main part is made up of ivory (a) which towards the ends of the curve blends with a secondary dentine (b). The ivory is covered with cement (c) while on the inner aspect there is a layer of tissue (d) which has a stalactitic formation and under the microscope has the appearance of dentine.

Before making the sections of this specimen, I was inclined to regard the portion (A) Fig. 14, as formed entirely of the original tusk. The section shows that it is made up of a part of the original tusk together with a mass of tissue of fresh formation which has been formed to enclose a piece of ivory detached at the time of injury. The pulp has reacted towards the flake of ivory in exactly the same way as it does to bullets which occasionally find the resting place in the pulp of an elephant's tusk. In such cases, secondary dentine is formed around the foreign body until it is cut off completely from the rest of the pulp. This specimen is an excellent example of the results that may follow in a tusk fractured in a longitudinal direction. The splinters of the tusk that remain in the bone may still retain their attachment to the periosteum and recovery of growth may follow.

The specimen, fig. 15, is a fragment 43 cm. long of a tusk injured at an early period of growth. In this case the animal was found dead. A section was made through the tusk at the position marked by the arrow. The lower part of the section, fig. 18 shows a crescent shaped area of ivory (a) covered on the outer aspect with cement (c). Beyond the ivory there is a layer of secondary dentine (b) and above this and to the left an area (d) which appears structureless and is probably of the nature of ivory; to the right of this there is secondary dentine (e) made up largely of branches of hard tissue arranged in a fan-like manner with their bases towards the top of the section. The general impression one forms of the section is that the disorganized pulp had made headway towards the formation of normal ivory.

The Odontological section of the Museum of the Royal College of Surgeons contains an excellent collection of pathological ivory, the typical specimens have been brought together, and are exhibited in a case in the central gallery ; these specimens have been described in the Dental Record, Vol. xlvi, January 1926.

Additions to the collection are always welcome for they may, and often do, fill gaps in a series illustrating a certain type of abnormality ; in this respect the specimens presented recently by Mr. Morris and Mr. Pawsey have proved most valuable.

FISHING IN THE RIVERS OF THE C. P.

BY

MAJOR W. B. TREVENEN

(Honorary Secretary, Central Provinces Angling Association)

(With 3 text figures)

One so often hears the enquiry from new arrivals in some district or station of the C. P. 'Is there any fishing near here?', 'What does one get?' or 'What sort of rod is the best and what tackle do I want?' that possibly a general descriptive article on the type and style of fishing in the Province may prove useful to future residents in or visitors to this Province.

Of course there is one obvious answer to the above queries, i.e. 'Join the C. P. A. A. and buy the latest copy of the *Journal* (future numbers you will get free, and then you will quickly know all there is to be known about it!') True as this is, there must, however, be a starting ground from which the novice must take off, and I propose, therefore, at the risk of being considered, perhaps, rather tedious to the more advanced and skilled fishermen among my readers, to assume that the majority of them know nothing or, at any rate, very little about fishing in the rivers of the C. P., and that they have had but a slight experience in dealing with the wily *Barbus tor* or any of his numerous relations.

The Central Provinces are well served in the way of rivers, these being far too numerous to mention individually, but all of them hold good fish and are probably worth fishing at some time or other during the year.

Speaking roughly, the north of the Provinces is watered by a network of rivers and streams which empty themselves either into the Jumna or the Son, both of which two rivers are, of course, tributaries of 'Mother Ganga'.

To the east the majority of streams are tributaries of the Mahanadi, which river actually rises in the C. P. and flows into the Bay of Bengal a little north of Puri, the recognized watering place of Calcutta.

In the south the country is drained by the rivers Penganga, Pranhita and Indravati, all three of these being tributaries of the Godavari, flowing into the Bay of Bengal towards the north of the Madras Presidency.

Ths west of the Province is watered by the tributaries of the Rivers Tapti and Nerbudda, both of which flow into the Gulf of Cambay, the Tapti at Surat, and the Nerbudda at Broach, a little further towards the north.

I imagine the latter river, the Nerbudda, is the best known river in the C. P. This is accounted for by several reasons, one being the veneration in which this river is held by Hindus; another reason is the fact that this river flows through or near more important civil or military stations such as Mandla, Jubbulpore, Narsinghpur, Hoshangabad, than does any of the other large rivers in the Provinces, and it is therefore considerably more accessible than most of them to the majority of residents. Another reason for its fame, and this is one with which we are more intimately concerned, is the well-known and established fact that the finny inhabitants of this river, and also of its tributaries have a decided preference for gram as a bait with which to be enticed from their deep or rocky fastnesses, to the exclusion of almost all other kinds of bait, with the exception of 'atta' in the case of the large mahseer. One hears occasionally of a fish being taken on a spoon or minnow, but these occasions are, unfortunately, comparatively rare. This preference for gram and 'atta' undoubtedly extends to other rivers in the C. P., but it appears to be a general rule that the farther one gets away from the Nerbudda, the more chance there is of using a spinning bait with success.

It is a thousand pities that this habit prevails, as there is some magnificent 'spinning' water in many of the C. P. rivers and if the fish would only take a spoon or natural bait as readily as they do in other parts of the country, the district would be a regular angler's paradise. Nevertheless, we have to be thankful that they will take *some* bait and although the use of 'atta' can never be regarded as a really sportsmanlike method of fishing, it is very often the only bait with which the larger fish can be hooked.

As regards gram-fishing, however, there is a good deal to be said in its favour, in spite of the fact that the angler who has been accustomed to fly fishing at home or to casting and spinning for mahseer in the rivers of Northern India is at first rather apt to despise this method of angling.

The greatest drawback to this kind of fishing is, in my opinion, the necessity of previous baiting in order to be really successful, and this is a disadvantage that cannot be circumvented. The same remarks apply, of course, equally to 'atta' fishing. On the other hand, there are a number of points which may be brought forward in support of gram-fishing. It is a branch of angling in which a considerable amount of skill is required, being not unlike dry fly fishing in many ways. Indeed, in many places, it is possible to stalk and cast over a good rising fish, and unless the gram is presented in a natural manner and without any 'drag', the chances are that the fish will *not* take it. Again, only a light rod is required, one of the well-known dry fly type being ideal for this kind of work and the finer the tackle is, the better the sport will be, for though more breakages may occur by the use of fine casts, etc., there will certainly be many more fish hooked *and caught* than there will be when coarser tackle is employed. Also, compared with 'atta' fishing, it is so very much cleaner, and once one gets 'the hang' of it, there is very little trouble or time wasted in adjusting the bait.

As I have already remarked above, the larger mahseer unfortunately much prefer 'atta' to gram, and unless the sportsman is content with fish running up to 5 lbs., or so, he will have to descend to the use of 'atta' at times, especially if he entertains any hopes of establishing a new record! The largest recorded fish caught here on gram since 1927 is 8½ lbs., and I myself have caught them over 7 lbs. in weight, but these 'catches' are rather exceptional for gram.

In places, therefore, where the really big fish are known to lie, it is better to start with 'atta', as the first few casts are nearly always the most productive, and one can then switch over to gram a little later, though this course is rather inclined to spoil the chances of getting a really good fish of 5 lbs. or more on *gram*, which might otherwise have taken the bait during the early casts had the 'atta' not been used. However, one cannot have it both ways at the same time! In places where three or four 'runs' have been baited, I usually first try for the real big fish in the most likely 'run' of the lot with 'atta', changing over later to gram according to fancy, but confine myself entirely to gram in the remaining 'runs' thereby standing a very fair chance of hooking a good fish on this bait during the first few casts in each of the latter places.

There is no doubt that casting with gram is a far more enjoyable and sportsmanlike method of fishing than is the use of 'atta', and the true sportsman will probably derive far more pleasure from the landing of a handsome five-pounder which in the first case he has 'spotted' feeding regularly on the grains of gram floating down, and subsequently carefully stalked and then successfully cast over and hooked, than he will from the capture of a considerably larger fish which he has not previously seen but which has taken his 'atta' somewhere deep down below and out of sight.

I will now proceed with a description of the tackle and gear most suitable for gram-fishing.

Rod. The best rod for gram fishing is a split cane trout rod about 10′ or 10′ 6″ long and slightly on the stiff side. If the rod is too whippy, it is difficult to pick the line up quickly enough when striking or casting. One of Hardy's 'Gold medal' fly rods, of the above length is ideal for this kind of work. Just the requisite amount of stiffness, very light, and yet powerful enough to kill a really big fish.

Reel. The qualifications of a reel are lightness, a good line-carrying capacity, and a drum large enough to ensure a quick recovery of the line when necessary. A reel which I can thoroughly recommend is one of Hardy's 3⅝″ 'Perfect dry fly reels' with a large barrel for quick winding, weighing only 8 ozs. This reel will hold about 100 yds. of the right-sized line and backing and is yet not too heavy for the rod.

Whilst on the subject of reels I would most strongly recommend every mahseer fisherman to insist on having a 'screw grip' winch fitting, or some fitting of a similar type, fixed to his rod. Nothing is more annoying than to find your reel suddenly detached and dancing at your feet in the middle of the first rush of a good fish. It is sometimes possible to recover and replace it in time if one is skilful, but more generally disaster follows. With a 'Screw Grip' fitting, such an occurrence becomes impossible.

Lines. There are several points to be considered in the choice of a line such as colour, quality, size, length, etc. I mention colour first advisedly as although this is one, if not *the* most important detail to be considered, very few anglers sufficiently appreciate that fact. I have already drawn attention to the importance of colour in previous articles (Misc. Art. No. IV, *C.P.A.A. Journal*, May 1928, and *Bombay Natural History Society Journal*, May 1926) on both of which occasions I described the circumstances under which I became so convinced on this point. I will not again go into details, but will merely remark that the proof was sufficiently conclusive.

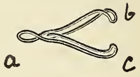
Now comes the question, 'Which is the best colour?'

This is not quite so easily determined as the best colour appears to vary with the locality or water. One colour which I do *not* advise is a fairly light orange or yellowish waterproof line with a black thread such as is so often used for trout lines at home. This line, apparently, scared the fish more than any other line I ever used, especially in still water. When I was in Poona some years ago, fishing chiefly in lakes, I always used Manton's 'Saline' lines and was very successful with them. They are beautiful lines when new and their colour, green and black, seemed to be just what was wanted, but the enamelling did not, to my mind, last too well, particularly if much used for trolling. I imagine that the constant twist in one direction caused the enamel to crack. This did not, however, appear to impair their strength to any great extent but at this stage the line quickly became waterlogged and was not, therefore, good for casting. I was not too successful with this line in the rivers of the C. P., and the next which I tried was an American undressed white 'waxed' silk line. This I found excellent, particularly after the rather new whiteness of the line had been toned down by use. Unfortunately I was unable to obtain any more of it the following season. These *waxed* lines do not last anything like as long as a well *dressed* line, and must be renewed at least every season. I then tried several varieties and eventually decided on one of Manton's 'Forindia' lines. This line is still in use and is now well on in its second season, yet, except just for the end where all the wear and tear occurs, it appears to be quite as good as it was when I bought it. Mantons stock this line in three sizes, 'fine', 'medium', and 'stout', and for gram fishing I do not think one can do better than use 50 yds. of their 'fine' quality with a breaking strain of 18 lbs. spliced on to 50 yds. or more of 'backing' such as 'Saxon line No. 15,' also stocked by Mantons, Calcutta, in 50 yds. reels. The 'Forindia' line is brown with a very fine black thread, and though inclined to be slightly 'tacky' when first used, this tackiness very quickly wears off. The reel mentioned above will hold 100 yds. of this line and 'backing' comfortably and I do not recommend the use of a line of less length than this, as, although my largest fish in these rivers so far is under 15 lbs., I have on two or three occasions only had a few turns left on the drum of the reel!

Lock-Link-Spring. We now come to one of the most important items concerned with gram-fishing, which is the link connecting the line with the trace.

The peculiar suitability of this link for this type of fishing was first discovered by Major E. J. P. T. Walker and described by him in his article on Gram-fishing which appeared in the first *Journal of the C. P. A. A.* in 1927. It is known as 'Hardy's Lock-Link-Spring', size No. 7, and by its use, the cast can be detached, the gram threaded on to the gut, and the cast reattached, all in a few seconds.

To *attach* the cast to the link, hold the latter in the left hand at 'A' in a hornizontal position with 'B' and 'C' pointing towards the right hand. Hold the loop of the cast between the finger and thumb of the right hand just at the knot and pass the loop over the arm of the link 'C' pressing the gut well home towards 'A' and then draw back again to the right when the cast will be found to be lying firmly inside both 'B' and 'C'.

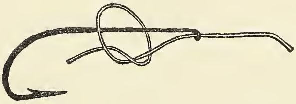


To *detach* the cast, hold the link in the left hand as before; then, with the right hand take the loop of the cast which is then lying inside 'B' and 'C', holding it at the knot, and push it back towards 'A' until it touches the left hand; then lower the right hand until the loop is hanging nearly perpendicular just in front of 'A', then slowly raise the right hand again bringing the *further* side of the gut loop up between 'B' and 'C' and the *nearer* side between 'C' and yourself. Continue the upward motion, at the same time pulling the loop towards the left hand, when it will at once become detached.

The above directions sound somewhat complicated, but after it has been done once or twice, the whole process becomes automatic and can be completed in a couple of seconds.

These links can be obtained direct from Hardy's or else from Mantons, Calcutta. They are now generally supplied 'bronzed', but I prefer them 'bright'.

Casts. Hardy's 1. X., 2 yds. long, with a loop at the top, and the bottom end left loose to tie direct on to the hook is the most useful size. If the water is very still and clear a still fine cast, 2. X. can be employed, or if the water is rough and heavy, a slightly stouter cast, i e., Hardy's 'Strong Trout', can be put on, but personally, I rarely use anything else except 1. X. For 'atta' fishing the stouter cast is preferable. The knot with which I tie the hook on to the cast is Pennel's 'Half-Hitch Jamb Knot'. The illustration of the knot makes a further description unnecessary. If the gut is well-soaked before tying, this knot will practically never slip.



Hooks. The hooks most suitable for gram fishing are Hardy's 'Capt. Hamilton Eyed Hooks' sizes No. 5 A, 7 or 8. These Hooks are made of wire sufficiently fine that they do not sink the gram too quickly, and the eye is small enough to pass through the bored gram without breaking the latter. I almost invariably use the smallest size (5 A) with two grains of gram, but some anglers prefer one of the larger sizes with three grains. These hooks are stocked by Mantons, Calcutta.

Drills for Boring Gram. This is another *most* important item. If the hole is too large, the gram will fly off at almost every cast and certainly at every touch, whilst, again, if too small, a large number of grains will be broken whilst actually threading the bait on to the hook with a consequent loss of time, very often just at the moment when the fish are biting well.

The best drill, I find, is a small ' twist ' drill, with the end ground down to a point and measuring a *bare* sixteenth of an inch in diameter. This is *exactly* the right size for the above hooks. I have also another drill measuring a *full* sixteenth, but even this variation in size though apparently trifling, makes a great difference in the length of time for which the grains remain on the hook. Spear-headed drills of the right size can sometimes be obtained, but many more grains are split during the process of boring owing to there being no backward outlet for the powdered gram.

Landing Net. It is well worth while getting a good large net with a ring not less than 26″ diameter and the net at least 24″ deep. This will land a fish well over 20 lbs. If a collapsible net is purchased, make certain that the ring is strong enough. The majority of those offered for sale always strike me as being too flimsy.

Before going on to describe the actual procedure followed on a day's fishing, there are a few other points apart from the actual tackle which the angler who is a novice to this style of fishing will do well to remember :—

Baiting. For this type of fishing it is necessary to bait beforehand the ' runs ' or pools in which it is intended to fish. This is necessary for two reasons, i. e., firstly, to attract the fish to those particular spots, and secondly, to accustom them to the sight and taste of the bait with which it is hoped to capture them. Baiting should be commenced *at least* five days before the actual day of fishing, and results will probably be better if it is carried out for a week or ten days, particularly if it is a place that has not been previously baited. For the first few days of baiting, it is as well to allow one seer of gram for each ' run ' daily, i. e., one pound in the morning soon after sunrise, and another pound in the evening about an hour before sunset. This allowance can be reduced by half after a week, if the baiting is continued beyond that period. Should it be intended to fish with ' atta ' for large fish, a pound or so of this should be allowed for a few days previous to fishing. The ' atta ' should be made up into small balls and thrown in a little time after the gram when the fish have already been attracted by and started to feed on that bait. It is a mistake to cut the baiting allowance too fine and it is far better to err on the side of generosity in this respect, as, however honest your shikari or the local dhimar may be, a certain amount of the gram is certain to find its way down their throats rather than those of the fishes! It is preferable, I think, to employ a local man for the baiting, thereby also obtaining a certain amount of local interest in the proposed expedition, whereas if a shikari or orderly is sent out for the purpose, the local Dhimars are not above casting a net into the water as soon as the shikari's back is turned after baiting.

Taking Cover. If the angler hopes to catch any really good fish, he must first learn the importance of taking cover and keeping himself out of sight as much as possible. These remarks apply particularly when approaching the water for the first cast after the preliminary handful of gram has been thrown in, for that is the moment when the best fish may be expected, when they have not yet been scared away by the landing of other fish. Also, do not walk right up to the water on your first arrival at the pool or ' run '. Keep your admiration at a distance! Another point—Do not let your shikari, who is to throw in the occasional gram, take up his position too near either to you or the water, but keep him a little upstream and out of sight, if possible. Make use of any long grass or bushes when casting, or, if there are none of these about, try to select a position where there is a neutral-coloured background to yourself from the fishes point of view, and do not present yourself against the skyline. Although even the large fish will come and feed close to the spot where the shikari, in full view, is throwing in the gram, the sight of a Sahib with a shining rod in his hand is immediately associated with danger and ' Hey ! Presto ! ! '. I have, before now, seen good fish feeding within a few yards of the villagers bathing or washing, and on one occasion last year (1929) after wading out and taking cover in a clump of fairly high reeds, I rose and hooked a fish of between two and three pounds which was rising in the middle of a small herd of buffaloes who were wallowing in the stream. I had quite an exciting time steering the fish clear of these animals and at one moment actually had my line hung up for a few seconds in the horns of one of them, but luckily managed to clear it again before the animal got alarmed, eventually landing the fish, apparently to the great astonishment of the buffaloes!

Another thing that undoubtedly *does* frighten the fish is the sight of one of their number struggling at the end of the line. Consequently, as soon as a fish is hooked, every effort should be made to get him away upstream or downstream of the actual spot where you are fishing. If it is a large fish, he will probably do this without your help! At the same time, do your best to keep him from returning and try and land him some little distance away. It is quite a good plan to throw in a small handful of gram directly a fish is hooked. This appears to distract the attention of the remainder to a certain extent from the sight of their struggling comrade! If, however, one has no choice but to land the fish at the same spot, give the place a rest for five or ten minutes, throwing in a few grains of gram occasionally with the idea of getting them on the feed again.

Casting. In gram-fishing the angler who can achieve a reasonably long cast has a great advantage over the man who is not so skilful. As a rule the best fish generally appear to lie the furthest off and, certainly in still or slowly moving water, the largest fish will usually be hooked when fishing with a fairly long line. When fishing water where the current is slack or only flowing fairly slowly, it is far better to fish *upstream*, as a good fish will rarely take a grain of gram drawn *against* the current. This is, indeed, only natural, as a fish, if he reasons at all, must be suspicious of an inanimate morsel of food moving against the stream. Even when fishing running water where the current is too rapid to fish upstream, one should cast across and let the line swing gently down with the stream until the full length of line is reached after which a fresh cast should be made.

Occasionally when fishing a long ' run ' that finishes in the head of a pool, one notices good fish rising right at the end of the ' run ', well out of reach of a cast either from the spot from which one is fishing or from either bank lower down. It is sometimes possible to get on terms with these fish by letting out a long length of line and letting the current take it down, provided the stream is strong enough to keep the line more or less straight. If the reel has no ' free ' action the line should be pulled off by hand, and then five or six feet let off at a time, and it is generally directly after letting off these few feet of line that one hooks a fish. Once the line is tight again the bait starts to drag, and the fish are therefore shy of it until the next lot of line is let go and the bait starts to move downstream again. I have occasionally hooked good fish by this method with nearly fifty yards of line out. When one starts to reel up again it is not a bad plan to swing the end of the rod round to the side of the ' run ' thereby causing the bait at the far-end to swing off into some of the eddies at the side where one may occasionally get a good fish.

In the actual casting with gram it is better to make just a slightly longer pause than is done with a fly before coming forward again, otherwise one is apt to whip off the gram. The man who can throw a long straight line and drop his gram in the water exactly where he wishes and *without a splash* will be far more successful than one who is less skilful.

Use of ground bait whilst actually fishing. The local Dhimar or shikari who accompanies the angler requires careful watching on this point. As a rule, they are far too lavish with gram. I often wonder if they are half so generous with it when baiting beforehand ; when there is no sahib to watch them ! By all means throw in a good handful or so when you first commence so that you may get the fish well on the move, but after that you want to use it much more sparingly. Your local man who carries the gram will probably, if left to himself, continue a steady flow of gram for the whole period for which you are fishing (unless the gram first comes to an end when he will probably suggest that you should send him to the nearest village to procure some more); with the result that the fish become gorged long before you are ready to stop fishing, and if it is in still or sluggish water, the whole place is full of floating or sunken gram which the fish are not hungry enough to eat. Even in running water, although here you certainly require more than in still pools, it is easily possible to overdo it, as all the eddies at the sides soon get covered with floating gram with the same results as above.

The shikari appears to think that because he can get more rises by throwing in large quantities of gram (which is true enough) he has then carried out *his* part of the show and it is then up to *you* to catch the fish. It stands to reason, however, that if there are large quantities of gram floating down, the larger and shyer fish are not going to touch any grain that appears at all suspicious but will confine their attention to those about which they have no doubt. On the other hand, once you have got the fish moving, if you only throw in a few grains at the time the competition to secure them will be much more keen. I sometimes do all the gram-throwing myself, having a small bag with a wide mouth hung on my belt, which I fill up occasionally as needs be. (A canvas camera case makes a very useful substitute !) This is a much better plan than carrying it loose in the pocket as you do not then find that you are smoking gram when you next light a pipe, or that the key of the wine cupboard is choked with particles of broken gram when eventually you arrive home on the verge of collapse from want of a liquid stimulant !

I leave the main supply of gram in the charge of one of my own attendants (*not* the shikari) with strict instructions to allow the latter on no account to touch it. These precautions are necessary as the shikari, if he gets half a chance, will surreptitiously try to get hold of it and start throwing some in when your back is turned, honestly thinking, I believe, that he is thereby doing you a good turn in spite of your orders to the contrary.

If the reader has had sufficient patience to persevere in the perusal of this article up to the present point, and is not too weary as the result of his efforts, I will now ask him to accompany me, in imagination, on a day's gram fishing on one of the rivers in the Central Provinces.

Having made all our preparations overnight, we leave our bungalow one April morning whilst it is still dark, early enough to arrive at the spot where we forsake the 'pukkha' road for the cross-country track just as the day begins to break. There is now sufficient light to pick our way carefully round or over any obstruction *en route*, and we reach the river just at sunrise to find our shikari and a few other interested observers waiting to welcome our arrival. Hastily putting our rod together, and securely attaching the reel, we thread the line through the rod rings and tie on one of the 'Lock Link-Springs' with a double sheet bend, or some similar knot, ready for the cast. Then strolling towards the river bank, but taking great care not to approach so near as to frighten any fish that may be on the alert, *and seeing that our attendants do likewise*, we take a cautious peep at the water and settle in our mind the exact position from which we intend to launch our attack.

As this is a fast-running piece of water, we send our shikari a few yards upstream near the head of the 'run' and carefully station ourselves behind a convenient bush from which we can reach the tail end of the 'run' where it joins the pool below. We next take out the gut cast from between the pieces of damp flannel in which it has been soaking with the hook already attached, and, pinching the gut loop, which is now soft and pliable, between finger and thumb, thread on a couple of grains of gram and slip them down the cast carefully over the eye of the hook until they both lie evenly on the shank. We then attach the cast to the link and are ready to commence operations.

The shikari has by this time thrown in a handful or so of gram and the water in front of us is alive with 'rises', but we see nothing very big. Never mind! Give them half a minute or so longer and another small handful. The larger fish have hardly had time yet to realize that it is breakfast-time.

'By Jove! That's a whopper!!' we ejaculate, as our heart jumps almost into our mouth at a magnificent rush and swirl just at the tail of the run. Now we'll have a try to persuade him that our particular bit of gram is just the relish that he requires for breakfast!

Still crouching behind our bush we make a preliminary cast or two in the air to get out the line and judge the distance, then make our cast across the stream so as to let the gram alight quietly on the water a yard or so upstream on the fish. We now let the stream do the work of floating the gram down over him, lowering the point of our rod slightly so as to avoid any upstream 'drag' on the bait until it has passed the critical spot.

Nothing happens, however, and the line has now stretched out to its full extent, and the bait is stationary, dragging against the stream, so we make another cast as before.

'Ah! that's better!' as, just after our gram alights for the second time, there's rush and a swirl, the line tightens, and off our fish goes downstream into the pool, with the reel screaming, long before we have any time to worry about the vexed question as to whether we should or should not 'strike' him!

This appears to be a real good fish, so, beyond keeping a steady strain on the line and the rod well up, we cannot do much more than follow him downstream a bit and get him away from the actual spot where we are fishing, telling the shikari to throw in another handful of gram to distract the attention of the other fish before he follows us with the landing net. So far we have made no impression on our fish who is now some sixty or seventy yards downstream in the still water of the pool below the 'run', and he appears to have made up his mind to go down the next 'run' fifty yards or so further below.

We gaze anxiously at the line left on the reel as this rapidly decreases and decide to slightly increase the pressure. This, together with the weight of the line, has the desired effect, though only just in time, as from a hasty glance at the reel we note that but a very few yards remain. However he *has* stopped, and now we must be ready to recover line at the very first opportunity.

For a few moments we can only reel in slowly as he is still apparently anxious to continue his flight downstream, but at last he allows himself to be persuaded to come upstream again. Now is the time we appreciate the special large drum on the reel, as without this, it would scarcely be possible to wind in rapidly enough to keep a constant strain on the line, which we *must* do unless we want to run a great risk of losing our fish. Even as it is, we find it necessary to move upstream ourselves in order to prevent the fish from approaching us too rapidly. Luckily now he makes for the other bank which makes it easier for us to get on terms with him, and we steadily recover line until we have only twenty yards or so out. We guess, however, by the feel of him that we are not going to land him just yet and, sure enough! as soon as we reel in a few more yards he catches sight of us and is off again down the pool. This second rush, however, is neither so long nor determined as the previous effort, and we stop him again after about fifty yards and recover the line as before. This happens two or three more times, but each rush is distinctly taking it out of him and we now feel he is very nearly ready for the net.

Selecting a spot, free, if possible, from snags, sharp-edged rocks, or weeds, we send the shikari to the water's edge, cautioning him, if necessary, not to move about but to make himself as inconspicuous as possible, and to hold the net ready *and still*, a few inches under water so that we can tow the fish over it, and all he then has to do is to raise it quietly when the fish is in position. We then bring our victim up for the final act but as he views the net for the first time, he makes a last despairing effort to break away. We turn him, however, in a yard or so and this time he really *is* done so, towing him gently over the net, the shikari gently raises this and lifts him out on to the bank. As soon as we have extracted the hook, we call for the spring balance and find we have caught a fine fish weighing over 6 lbs., with which we are well content as the result of our first effort for the day, so we light our pipe and give the water a rest for five or ten minutes before a further attempt.

Subsequently we resume operations with varying success, but our first fish easily remains the best for the day as, indeed, we had anticipated.

As it is now well after ten o'clock and the fish appear to have finished feeding, we decide to adjourn for breakfast and then 'lie up' through the heat of the day. After tea we propose to move on to another baited spot on the same river a few miles distant.

Arriving at this latter place about 3.30 p.m., we find it to be water of a type rather different to that in which we were fishing in the morning. Here the water which has been baited is the tail of a pool separated from another large pool below by a short narrow 'run' of only a few yards.

As the shikari tells us that we shall probably be more successful in the tail of the upper pool rather than in the 'run' itself, we decide to follow his advice and begin to consider how we shall commence operations.

Instructing him to throw in a small handful of gram in the spot which *he* considers the best, we watch the result. Almost as soon as the gram has reached the water there is a regular 'boil', the majority of the 'rises' being small, though there are some good fish among them. A second small handful produces a similar result but there are now considerably more large fish. We note, however, that the latter are chiefly feeding on the gram that has fallen furthest away from the bank. As the water is unrippled and the current is slow, we decide to fish slightly upstream especially as there is a convenient patch of reeds about three feet high at the edge of the bank, behind which we can comfortably kneel.

As soon as we are ready to cast we tell the shikari to throw in another small handful in the same spot, and, carefully watching him, we cast at the same time, dropping our baited hook among his gram just on the spot where the bigger fish were rising a few minutes ago. Another 'boil' follows and almost simultaneously our rod bends nearly double and off goes our fish downstream making for the 'run' below.

We put on all the pressure we dare as there is a small rock in the middle of the 'run' and if our fish once passes down on the further side of this, we may expect trouble. In spite of our efforts, his rush is too strong and determined for us to check and down through the 'run' he goes (of course on the wrong side of the rock!), and we feel our line beginning to chafe against the sharp edge of the obstruction.

If the fish had only decided to fight it out then and there in the 'run', the line would certainly have very quickly parted, but, luckily for us, he continues his rush down into the pool below and consequently, by running upstream a few yards, we are able to lift the line clear over the rock which is, fortunately, only a foot or so above the level of the water. It is now a very much simpler matter to deal with him, and the tide of battle has quickly turned in our favour for here it is all open water and no 'snags' so we can afford to take our time without hurrying him. After a few minutes, we tow him up to the net and find we have landed a nice little fish of between three and four pounds.

We now light our pipes so as to give the fish a short rest, but before many minutes the shikari, who had previously thrown in a little gram as soon as the fish was hooked, is urging us on to further efforts. At the next 'boil' we are unsuccessful, so as there is still a certain amount of gram floating about; we sign to the shikari not to give them any more for a time and we continue casting over any isolated rising fish, those furthest away in preference, as they are probably the larger.

This is the time to keep one eye on our friend with the gram as he is dying to throw in a handful with every alternate one of our casts, which would certainly produce a number of 'boils' to start with but would quickly put the fish off their feed.

However, by means of this independent casting, and also a few *judicious* handfuls now and again, we manage to keep the fish on the feed until it is time to go, when we find ourselves with quite a nice little basket of fish ranging from 4 lbs. downwards. With this and our morning catch we are well content, so taking down our rods we make our way back to the motor shortly after sunset with a really healthy thirst, looking forward in anticipation to the celebration of our success with a 'drap of the cratur', duly diluted with some of those nice cool sodas hanging in the canvas bucket at the back of the car which we know we shall find ready and awaiting our arrival, thus bringing a fitting close to another perfect day!

Whilst we are on the way home, if my reader is not too tired out with the days' excursion, I will pass the time in recounting a few tips which are well worth remembering.

Care of Rods. Keep them hanging up in their cases, and always see that the latter is thoroughly dry before putting them away for the night.

When putting up a rod, start with the top joints first, but last; reverse the process when taking it down. Hold the joints by the ferrules when fitting them together or taking them apart and *not* by the wood just above and below, otherwise you will strain them badly after a time.

Do not *grease* the joints, but just wipe them over with a *slightly* oily rag. This will keep them from sticking.

Care of Reels. If you have not a case for the reel, keep and carry it in a small baize or 'drill' bag, which will exclude the dust and dirt. When in use avoid resting the reel on any fine sand which may get into the working parts. Take it to pieces occasionally and clean it, giving the working parts a drop of fine machine oil.

Care of Line. Thoroughly dry the line before putting it away after fishing. Many a line has been ruined by neglecting to do this. Test the extreme end occasionally, and, if weak, cut off a few feet.

Cut Casts. Keep them in the dark and well wrapped up. They will remain good for a long time if both air and light are excluded. Soak them well before use. When fishing, it is a good plan to carry a spare cast in a round tin between some wet pieces of flannel, but take it out again on your return, otherwise the tin will rust and the cast deteriorate. Whenever fixing on a cast, take a glance at the loop at the head where you thread on the gram, and, if it is at all cracked or frayed, cut it off and make a new loop.

Hooks. Keep a few spare hooks ready in one of those paper 'hook pocket cases' supplied by some firms. It is very easy to make one up if you cannot get one as they are merely an open envelope with three square flaps and one pointed, which latter fits into a slot on the opposite side. The hooks are stuck into a small strip of a cork glued on to the *inside* of the envelope.

If you keep on 'missing' fish, look at the point of your hook as they occasionally get blunted on rocks. If necessary, touch it up with a file, or replace it.

Weighing and Measuring fish. Carry a spring balance and a measuring tape in your tackle box so that you may have an accurate record of any good fish you may catch. Test them both occasionally with standard weights and measures. If you have left your spring balance behind, the following formula will usually give you very nearly the true weight, in pounds, of a fish, if a mahseer :—

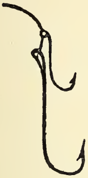
$$\frac{\left.\begin{matrix}\text{Length, } \textit{i.e.}\\ \text{(nose to } \textit{fork} \text{ of tail}\end{matrix}\right\} + \frac{1}{4}\text{ length)} \times \text{(Girth)}^2}{1000.} = \text{Weight.}$$

One final tip before we reach home, and this ought really to be printed in red ink, but I fancy I hear the publisher talking about extra expense and labour so will confine myself to heavily underlining the heading !

Doubtful Tackle. If you have the least doubt as to any part whatsoever of your tackle, condemn it, no matter whether it is rod, reel, line, cast, hooks, or anything else! If it is either of the first two, leave it at home until you have sent it away for repair, if it is worth it, but *don't* take it out with you on shikar. If any of the remainder, break them up into little tiny pieces so that neither you nor any of your borrowing pals may be tempted to try them *just once more* and so lose, very possibly, the fish of the season! This is a well-known maxim, but is there a single one of us, brother anglers, who has not at least one memorable occasion to regret which would not have occurred had we followed the above rule?

The above hints conclude my remarks on actual gram fishing and all I will ask my reader to do now is to glance through these few final paragraphs which he may find of help whilst he is smoking his post-prandial cigar and pondering in his mind as to when, where, and how he shall make his initial experiment in this fascinating branch of sport, before he retires to dream of the capture of some of those monsters which we saw to-day turning over in the pool below us, but who were far too wily even to look at the most attractive baits which we could present.

Fishing with 'Atta'. I personally as a general rule use a 'medium' gut cast and a moderate sized hook with a small hook lashed on the shank of the larger with the barb pointing out the reverse way. Mr. T. Latham, late I. P., who was a well-known fisherman in the C. P., in an article in *Journal No. 2* of the *C. P. A. A.* also recommends two hooks, but these are both eyed hooks, and the smaller of the two is threaded on loose above the larger, the two eyes lying one over the other, the smaller hook being just inside the top of the paste. He also recommends 'killin' wire instead of gut, and I can quite imagine that this is preferable where the fish run big and the water is really heavy as in some places of the Wainganga and Indravati rivers. Before fishing with 'atta', bait with both 'atta' and gram previously. On arrival, get the fish on the move with gram, then throw in some 'atta' made up into balls as large as marbles, until you see the big fish moving, then cast your baited hook so that it drops quietly down just where the fish are feeding.



Chilwa fishing. If the mahseer are not taking well, it is often possible to spend quite an amusing hour or so in the evening by putting on a small dark fly and fishing for chilwa which abound in most of the C. P. rivers. Moreover, they are very good eating, and, fried as whitebait, are far sweeter to the palate than is the mahseer.

Fresh-water Shark. (*Wallago attu*). Just at the beginning of the rains when the water first begins to rise, and when all the small fry are waiting below each little fall, is the time to try for these fish. Use a moderate or small size spoon or natural bait (chilwa). These fish are excellent eating.

Time of year for fishing. This varies considerably according to the river. For those streams which drop quickly after the monsoon probably October up to the middle of November is best.

During December and January it is apt to be too cold, and in many places they will not take at this time. This, however, is not a hard and fast rule, by any means, and I have heard of many good fish being caught at Xmas camps, and it was at this season when the largest fish recorded since the formation of the C. P. Angling Association was caught. In many rivers which have a steady flow of water all the year round, the cream of the fishing, particularly gram fishing, is undoubtedly during the hot months, i.e., March up to the end of May or early June, when the rains break. One advantage of this fact is that it fills up a portion of the year when there is not much other sport to be obtained. As regards the best period of the day for fishing, the first two or three hours after daybreak and an hour or so before sunset are undoubtedly the best times during the hot weather. In the cold weather the fish will not move much until the sun has warmed things up a bit, and they will stop feeding as soon as it gets chilly in the evening.

Now just a few words as to the fishing obtainable at the better known stations in the C. P.

Jubbulpore. A good centre, and within easy reach of the Nerbudda and several of its tributaries, including the Gaur, Temar and Hiran. The latter, without a doubt, provides the best sport in this district.

Nagpur and Kamptee. Within reach of both the Pench and Wainganga. The latter is probably the best fishing river in the Provinces. In the old days a fish of 60 lbs. is reputed to have been caught in the R. Pench.

Saugor. There is some really good fishing to be had in this district. The rivers Bewas, Bina, Betwa and Dhasan are all within reach.

Pachmarhi. The fishing here is not of the best, but any number of small mahseer and carp can be caught with a light rod and fine tackle.

In addition to the above places there are a number of civil stations such as Hoshangabad, Narsinghpur, Mandla, etc., where excellent fishing may be obtained. Most of these are out of the reach of military men unless on leave. I suppose the best district of all is Chanda, in the south of the C. P., where all those fine rivers, the Wainganga, Wardha, Pranhita, and Indravati eventually meet in the R. Godaveri. This centre is, unfortunately, not easy of access, but if leave can be obtained and an expedition arranged, it should be well worth a visit.

In a general article such as this, and which is already, I fear, rather protracted, it is impossible to describe in detail the various localities situated on each river, but as a final word of advice I would recommend all my brother anglers who may be residents in the C.P., or who may be contemplating a visit to that part of the country, to become members of the Central Provinces Angling Association. (Headquarters, Jubbulpore.) The total cost of joining the Association for out-station members (i.e. not resident in Jubbulpore) is only the small sum of Rs. 9, and thereafter an annual subscription of Rs. 2–8, in return for which they receive a copy of the *Journal* which is published each year in September.

Members joining between January and September can always obtain a copy of the previous year's *Journal* on payment of Rs. 2, if they are anxious to obtain information before the issue of the Journal for that year. A full report of the work of the Association is contained in this publication, and all the detailed information as to the numerous fishing localities is brought up to date and published each year. In addition to this, a series of articles of interest in connection with angling and shikar appears in its pages. The Association has now only been in existence for three years, but a number of interesting reports and much valuable information, which would otherwise have been lost to posterity, have already been collected and placed on record.

I will now bid my reader an affectionate farewell, with the hope that his perseverance in following me through so lengthy a discourse may be rewarded by the capture of many a fine mahseer, and that the results of his initial experiments of gram fishing may be so satisfactory as to convert him into an enthusiastic follower of this fascinating branch of angling.

My efforts will not then have been in vain !

SOME BEAUTIFUL INDIAN TREES.

BY

E. BLATTER, S.J., PH.D., F.L.S. AND W. S. MILLARD, F.Z.S.

PART V.

(*With two coloured plates, two black and white plates and 5 diagrams.*)

(*Continued from page 275 of this volume.*)

THE SCARLET BELL TREE.

Popular names :—Scarlet Bell Tree, Fountain Tree, Squirt Tree. The terms 'Squirt' and 'Fountain Tree' refer to the buds which on pressure squirt their liquid contents in a watery jett.

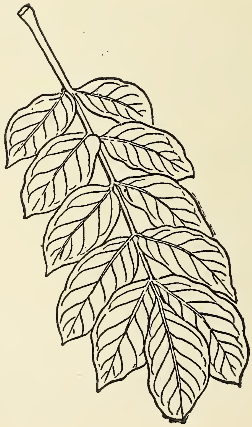
Spathodea campanulata, Beauv. Fl. D'Owar. I (1805) 47, tt. 27–28. Bignonia family (*Bignoniaceae*).

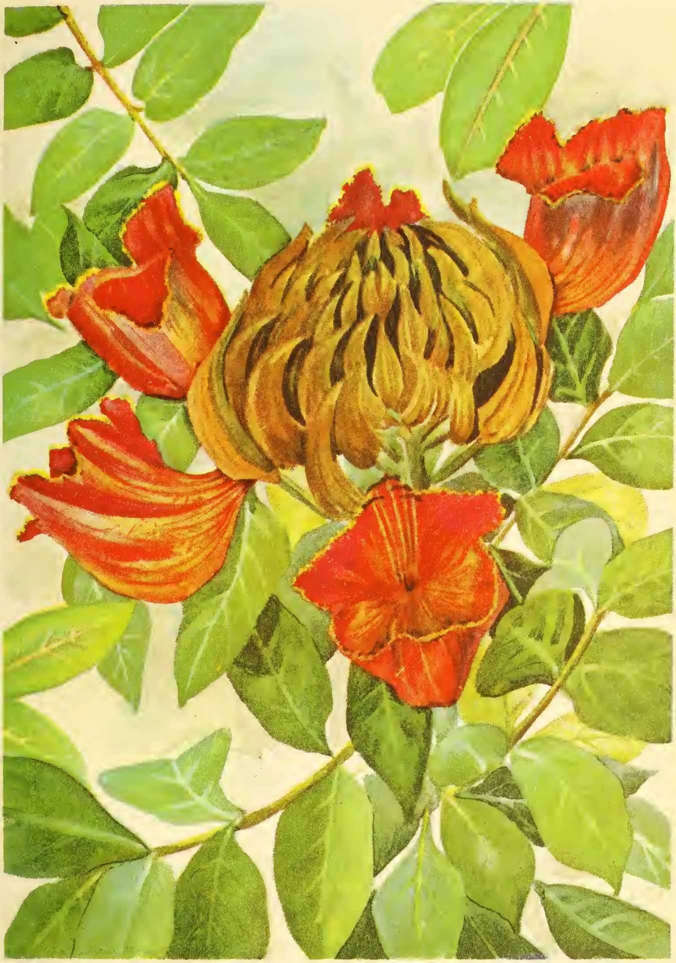
The generic name *Spathodea* is derived from the Greek meaning spathe in allusion to the spathe or ladel-like shape of the calyx. The specific name *campanulata* describes the bell-shaped flowers.

The Spathodeas, of which there are two or three species, are handsome evergreen trees with large pinnate leaves, and very showy orange-red or scarlet flowers.

Description :—This is one of the most glorious trees in Bombay gardens. Tall and erect, it grows to a height of 70 feet. Although a large tree in Bombay, it attains finer proportions in Bangalore where it has not to contend against the high winds which prevail in Bombay during the monsoon. In the drier areas the tree is deciduous for a few weeks during the hot weather but in the humid climate of the west coast it remains evergreen.

The tree has a large compound leaf. It is odd-pinnate. The leaflets or pinnæ grow opposite each other along the main axis which ends in a terminal pinna. There are from 9–19, smooth, oval, abruptly pointed leaflets. They have very short stalks and bear from 2–3 fleshy glands at the base. The shoots are velvety, the young leaves somewhat hairy beneath. During the cold weather the velvety olive green buds appear in huge clusters at the tips of branches. They are close-packed, curved over one another and form a compact globular mass which expands into a great panicle of lovely erect blooms, crowning the





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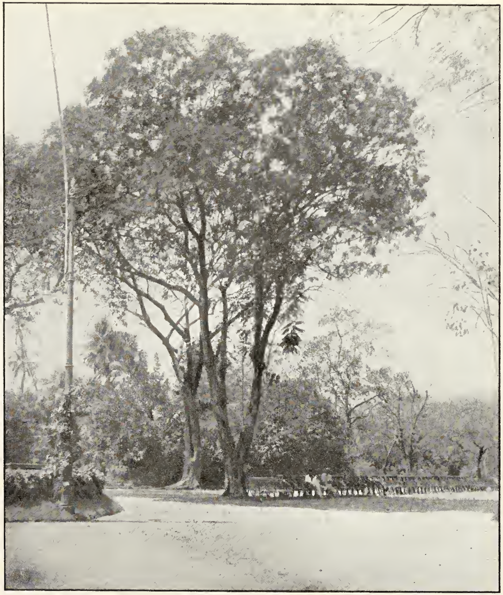
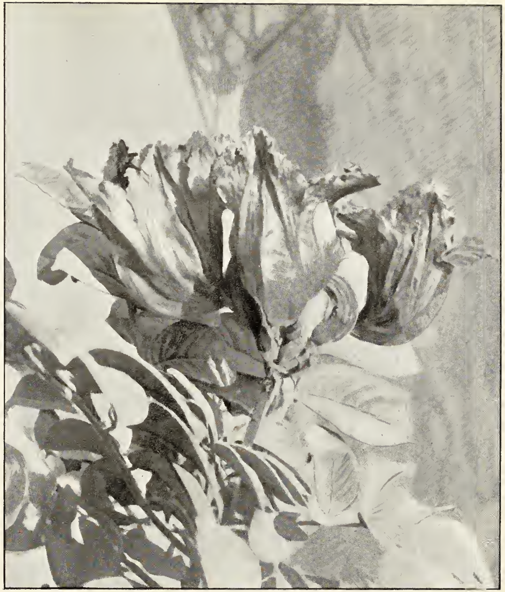
THE SCARLET-BELL TREE.
Spathodea campanulata, Beauv.
(2/5 nat. size.)



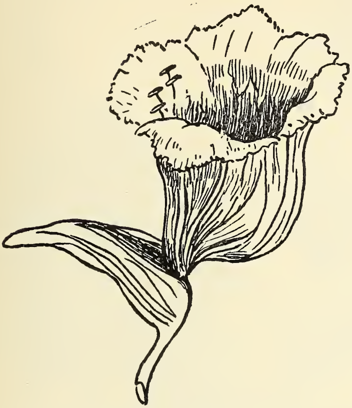
1. The Scarlet-Bell Tree
(*Spathodea campanulata*).
Victoria Gardens, Bombay.



Photos by C. McCann.

2. Flowers of the Scarlet Bell Tree
(*Spathodea campanulata*).

tree with a blaze of orange and crimson. Its vivid beauty compels attention. From its curving, boat-shaped calyx the flower emerges as a short tube which abruptly expands into a wide bell some 4″ long. The lobes of its petals are oval in shape and somewhat wavy. Externally the flower is orange at the base, deepening rapidly into brilliant crimson. It is edged with a fine yellow margin. Within, it is a rich yellow cup heavily streaked with red. The 4 yellow, protruding stamens are capped with pendant brown anthers. At the base of the style is the oblong papillose ovary containing ovules packed in several rows.



The fruit is a smooth, woody, oblong, lance-shaped capsule, pointed at both ends. The seeds are elliptic, broadly winged. The trees do not produce seed in Bombay and very rarely do so in Ceylon.

Flowering Season :—In Ceylon the trees flower throughout the wet season. In Bombay chiefly during the cold weather, particularly in February and March. Some individuals during the rains.

Distribution :—The Scarlet Bell Tree is a native of tropical Africa. It was introduced into Ceylon in 1873. There seems to be no record of when it was introduced into India.

Gardening :—For scenic planting in extensive grounds this is one of the finest trees in the country. Clusters of these trees make the expansive lawns of the Willingdon Club radiant during the cold weather. The tree thrives well up to an altitude of 4,000 feet and is suited to districts where the rainfall is not too great. It can easily be propagated from root suckers which appear freely round the base of the tree.

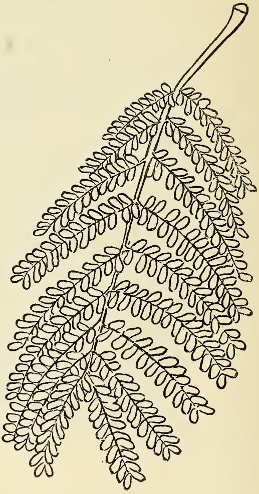
THE RUSTY SHIELD-BEARER.

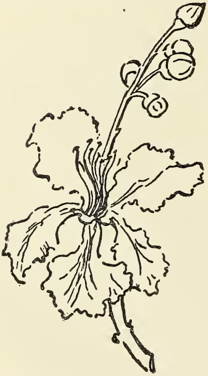
Popular names :—Rusty Shield-Bearer. Iya-Vakai (Tamil).

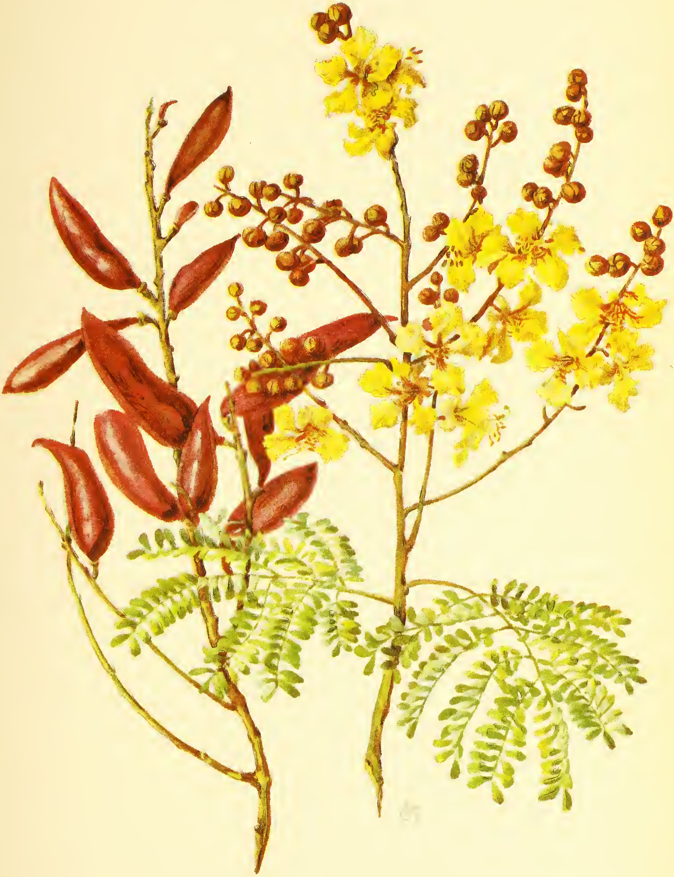
Peltophorum ferrugineum, Benth. Fl. Austral. II, 279. Family. *Cæsalpiniaceæ.*

Peltophorum, derived from the Greek, means shield-bearing in allusion to the shape of the pods which cover the tree after the flowering season. *Ferrugineum*, meaning rusty, describes the colour of the pods and tender shoots.

Description :—A large, handsome tree growing from 40–80 feet in height. It has a smooth grey bark and a spreading crown of many branches. The feathery mimosa-like leaves add to its handsome appearance. The leaves are twice abruptly pinnate. They consist of a main axis or rhachis from 6″ to a foot in length along which are arranged some 6–20 pairs of pinnæ, each bearing about 20–30 close-set, stalkless leaflets. Deep green in colour the leaflets are oblong in shape, notched at the apex and unequal-sided. They are smooth above, almost leathery in texture and covered with slight down on the under surface. In December there is a sprinkling of yellow leaves among the foliage of many of the trees in Bombay. Leaf fall then commences and continues through January and, though never completely denuded, by the end of the month the trees look ragged and untidy. The young leaves come out in early February. The trees are mantled in the tenderest green. In a week or two the colour changes to deep green. About mid-February rust-red, upright shoots covered with downy hair spring up at the tips of the branches. They grow rapidly and some become quite conspicuous. They develop into many branched sprays bearing a profusion of bright yellow flowers. Crowned in their abundance of blooms the trees are a wonderful sight. The ground below them is carpeted with fallen blossoms. The flower is cupped in a coppery-red, downy calyx. Its wavy, yellow petals are inversely oval in shape, hairy at the base and much crinkled about the margins. Its ten free stamens are clothed with dense tufts of hairs at the base and crowned with golden yellow anthers. The style is long and thread-like. The copper-red pods cover the tree in profusion. They are particularly conspicuous during leaf fall. The pods are oblong, flat, very thin and hard, narrowed at both ends and closely veined. They grow from 2–4″







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THE RUSTY SHIELD-BEARER.
Peltophorum ferrugineum, Benth.
(½ nat. size.)

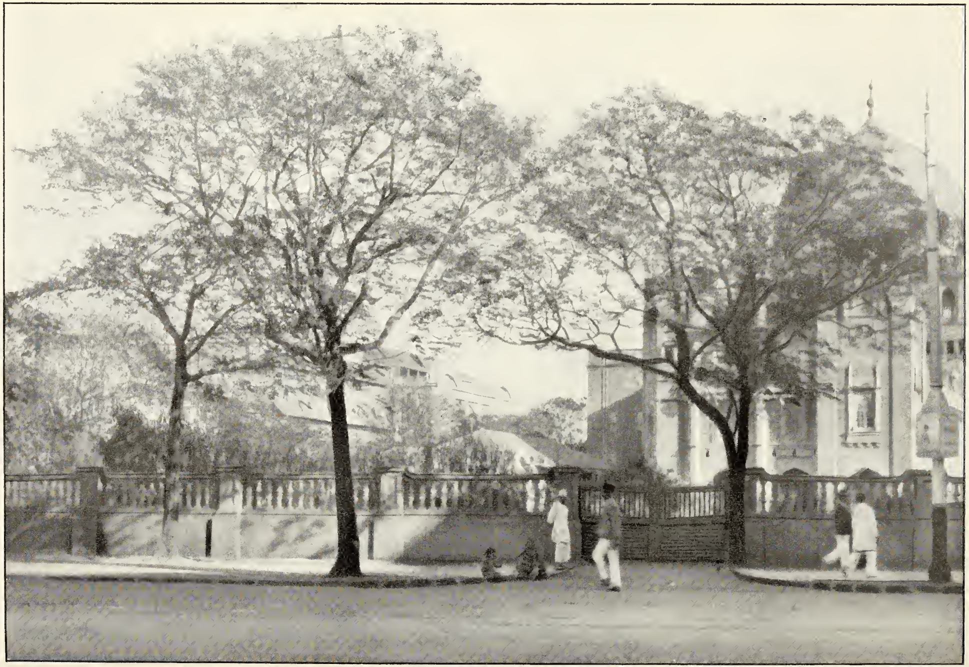
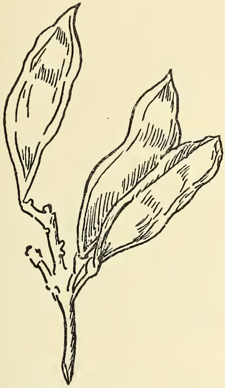


Photo by Salim A. Ali.

The Rusty Shield-Bearer (*Peltophorum ferrugineum*).
Trees growing in the vicinity of the Prince of Wales Museum, Bombay.

in length by about an inch in breadth. The seeds are brown.

Flowering Season :—In Bombay the flowering season commences in March, reaches its height in April and continues through May. Some trees come into flower later and are in full bloom during June. Alongside trees in full flower there are others in ripe fruit. There is a second blooming in September which is carried through October and November. Individual trees will be found in flower late in December.



Distribution :—The tree is a native of Ceylon, the Andamans, the Malay Peninsula and Archipelago and N. Australia.

Gardening :—Much cultivated for ornament. A large number of these trees have been planted alternately with Gul Mohur (*Poinciana regia*) trees on Hughes Road in Bombay. In April and May they make a wonderful blaze of colour, their bright yellow crowns contrasting with the scarlet heads of the Gul Mohurs. The tree is easily propagated from seed, the seed pods being freely produced.

Uses :—The timber is much in request for cabinet work (Hill). It is blackish, the sapwood white, coarse, fibrous, light. (Kurz Forest Florae of Burma.)

(*To be continued.*)

THE STUDY OF INDIAN BIRDS.

BY

HUGH WHISTLER, F.Z.S., M.B.O.U.

PART VI.

(*With a plate and two text figures.*)

(*Continued from page 290 of this volume.*)

SOME EXTERNAL CHARACTERISTICS OF A BIRD.

Colouration.

In the preceding articles of this series we have examined some of the physical characteristics of a bird and their correlation with the needs of a bird's life. Now I propose to point out some of the interesting aspects of the colouration and details of their plumage and give some idea of the lines on which these can be studied and what there is to learn from them. The aspects of the question are two-fold, namely the plumage and colouration themselves and their connection with habitat.

As a starting point I think we have to take it as certain that there is some reason behind every detail of the pattern of a bird's plumage. In looking through the galleries of a museum and seeing the fascinating diversity of the birds in the cases, one unconsciously asks the question ' Why (and " why " is perhaps the most valuable word of all in a naturalist's vocabulary) should birds be so varied and so beautiful—why is one bird green, another blue, a third with a varied pattern in browns and blacks ? ' The unimaginative mind is sometimes apt to reply that it is all a matter of chance, that the bird has to be some colour and so the colours are varied just for variety and nothing more. This of course is a fallacy. A bird is not bound to be some colour. It might just as well, from that point of view, be without colour. Everything is colourless unless something or someone provides it with colour. So as the birds have been provided with colours, like every other class in nature, the complete biologist must take notice of the fact and see what explanations lie behind it.

The way in which the actual colour of a feather is produced, either by pigment or structure or a combination of the two is fairly well known and a brief account of this has already been given (vol. xxxiii, p. 322). Similarly the colouring of bare skin and the horny coverings of beak and legs and the colour of a bird's iris are known to be due to the presence of actual pigments.

Several points require to be mentioned in this connection. There has been for many years a controversy as to whether an individual feather once grown can change in colour. By this, of course I do not mean a mere question of fading and bleaching which is practically universal in old and worn feathers; but whether a definite change of pigment can take place. At one time it was very widely believed that such a change was possible. Book after book will be found to contain statements to the effect that such and such a species changes into summer dress without a moult but by a change of colour in the feathers.

At the present day most of the supposed cases have been definitely disproved, and it is very doubtful indeed whether such a change of pigment is possible once the feather is fully grown. Those who still believe that it is possible, use our Indian minivets (*Pericrocotus*) as an example, referring to the change of the young males from yellow to red. It is an interesting point and one to which observers in India might well direct their attention.

It must be clearly understood that, on the other hand, there is no doubt that the pigment and colour of a growing feather can be affected, usually by abnormal conditions of food. The stock instance of this is what is known as 'colour feeding' for captive birds. All bird fanciers know that the richness of a canary's colour can be affected by the addition of saffron to its food, whilst overfeeding with hemp will make a Bullfinch dusky. It is possible that other factors besides food, enter into the changes of colour in captive birds, such as lack of exercise or possibly change of climate. Red is a colour particularly liable to suffer in captivity, when it is often replaced by yellow.

A very interesting example of this came under my own notice and the skin of the bird in question is now in my own collection. The Scarlet or Sepoy Finch (*Hœmatospiza sipahi*) of the Eastern Himalayas is well known as one of our brightest Indian birds, the adult male being entirely red except for the concealed parts of the wings and tail.

A male in full plumage was brought to England in 1907. At its first moult in England the plumage became mottled, some of the red being replaced by yellow. At the next moult the red was entirely replaced by yellow, and yellow was regularly assumed at each moult until the autumn of 1922. In that year it escaped in the first days of August and was recaptured in November. In the interval of liberty it had undergone, the moult and the original red colour had been restored. At the following moult the yellow colour of captivity returned and was retained until the bird died in the spring of 1927.

Care must be taken not to confuse the question of change of pigment in a feather with the change of the *apparent* colour of a feather due to wear. The Buntings (*Emberiza*) for instance, have a definitely different winter and summer plumage, and the change between them is effected without a moult. There is no change of pigment. It is simply a question of wear. If we examine a fresh, autumn specimen of the White-capped Bunting (*Emberiza stewarti*), for instance, we shall find that the whole of the colours and pattern of the summer plumage are present, but all the feathers are fringed with another colour. These fringes catch the eye and conceal the pattern beneath, greatly changing the appearance of the bird. As winter progresses normal wear removes the fringes of the feathers revealing the underlying pattern. In fact it would be possible with care and skill and a pair of scissors for anyone to turn an autumn specimen into full summer plumage. The extent of the change thus possible is often very startling. Compare specimens of the Common Rose-finch (*Carpodacus erythrinus roseatus*) shot down in Southern India in winter with others from the Himalayas in summer and it is difficult to believe that the plumage has not been moulted.

How far objective structural colours, i.e., those due to a combination of pigment with a special structure of the super-imposed colourless parts, can be changed by wear is not very clear. But the way in which the green feathers of a Bee-eater (*Merops*) tend to turn blue when worn, is presumably an example of such a change.

The question of the development of pattern is far more difficult; and pattern naturally falls under two headings, the pattern of the single feather and the pattern of the bird as a whole. But it must be remembered that the general impression of the colouration of a bird is the sum total of the colouration of all the uncovered parts of the feathers. Cross-barred feathers, for instance, cannot give the general impression of a striated bird.

Now it does not require a great deal of acquaintance with birds' feathers to realize that individual feather patterns tend to fall into three main types :—

(*a*) the whole coloured or self-coloured feather.
(*b*) the shaft-streaked.
(*c*) the cross-barred.

There are other types, such as the spotted and the particoloured, but they are far less common and many of them are easily seen to be nothing more than modifications and combinations of the three main types.

The self-coloured feather does not require elaboration, beyond the self-evident statement than an equal dispersal of pigment or equal modification of structure throughout the growth of the feather must produce this type of colouration. The streak and the bar are harder to explain, but the key to an explanation appears to lies in a common defect in feathers well-known to falconers under the name of 'hunger-mark'. Most of us are familiar with this defect which appears as if a knife had been drawn across the vane of a feather from edge to edge, bruising but not cutting through the substance in a straight line. This 'hunger-mark' or 'fault-bar' is simply due to malnutrition of the feather at the particular moment in its growth. It is explained much in this way. The feather during its growth is supplied with pigments from *proteins* in the blood or in the formative cells of the feather. The quantity available will naturally vary with the food supply. Reduced food means reduced blood pressure; while the rapid rate at which a feather grows and the disadvantageous position of the barbules with reference to the blood means that they are perhaps the first part of the bird to feel the effect of the malnutrition, however temporary it may be. Fresh food immediately corrects the temporary malnutrition and the blood pressure, but the feather has continued its rapid growth with the minute flow in every barbule which can never be rectified. This shows as the 'hunger-mark'.

Now it is suggested that barred feathers are to be explained in much the same way, that the dark bars represent growth at full blood pressure when the maximum amount of pigment is produced in the growing feather, and that the light bars represent periods of reduced blood pressure. It is known that blood pressure is normally low at night and it is thought therefore that the dark and light bars in a barred feather represent the rhythm of growth in alternate day and night. An interesting point regarding barred feathers may well be mentioned here. The pigment in a feather has evidently a strengthening effect, for in barred feathers, particularly for instance those of the waders—birds exposed to the greatest effects of weather, the pale bar wears more quickly than the dark bar, giving as a result a serrated edge to the worn feather.

The longitudinal shaft-streak, whether in its simplest form of a dark shaft to the feather or its most complete form of a dark feather with a pale edge (and of course *vice-versa* in both cases) is doubtless capable of some equivalent explanation.

The extent of elaboration of which such a fundamental type of colouring is capable, is seen in the 'eye' of the magnificent train of the familiar, yet gorgeous Peacock (*Pavo cristatus*). With all its effects of shading and irridescence, it is certainly one of the most elaborate feather patterns known, yet every stage in its evolution from a simple short shaft-streak may be traced in the plumage of a single bird.

There has been some controversy as to whether the streaked or cross-barred plumage is the older style of plumage in a bird. Those who urge the latter rely on the intermittent deposition of pigment in a feather as probably the oldest and simplest form of producing pattern. The advocates of the streaked or striped plumage, on the other hand, point to the prevalence of this type of colouration in the downy young of several very widely-separated orders as evidence that it is a very ancient stage.

There is no reason to believe that the Grebes are even remotely related to the Ostriches, yet the nestlings of these two groups display a precisely similar style of colouration—light longitudinal stripes on a dark ground—totally unlike the adult plumages. Striping in the downy plumage of the young also runs through other families, the plovers and waders, the gulls, the game birds, etc. It is undoubtedly a very ancient type of colouration, probably tending to be preserved as it is of protective value to the young. Spots are undoubtedly akin to stripes, spots sometimes tending to coalesce and form stripes, or to stripes being broken up and producing spots.

A comparatively slight knowledge of birds is sufficient to show the student that the plumage of birds as a whole tends to fall into definite types of pattern ; by this I mean that one is familiar with a dark cap, a superciliary streak, a white throat, a wing bar, a rump patch, various tail patterns as details that run through all the orders of birds, often in familiar combinations. There must be some explanation as to the origin of these recurring paterns, and one has been suggested by Glover M. Allen in a very interesting article in the *American Naturalist* Vol. xlviii (1914), p. 385 *et seq.* His ideas may be briefly summarized as follows. His investigations applied equally to mammals and birds.

The simplest form of colouration is probably that in which the whole external surface of a bird or mammal is practically self-coloured. In its primitive or at any rate unspecialized form, this colouration is usually greyish or brownish, and it is usually produced by the association of two or three pigments.

A pattern can be developed from this unspecialized colouration in two ways. There may be local changes in the relationships of the associated pigments, so that different groupings of the pigments produce different colours, or there may be a failure to produce any pigment at all in certain areas so that patches of white appear.

A practical illustration of the first method of differentiation may be looked for in two directions : (1) in dimorphic birds such as the owls where the red phase that runs through nearly all species (and is so familiar to us in India in the Scops Owl (*Otus sunia*) is probably due to the absence or reduction of a pigment found in the grey forms ; (2) in large groups of closely-related birds with recurrent types of colouration such as some of the parrots and fruit pigeons. Here the colouration of one species will be found to include patches which contain the complementary colours of similar patches in other species.

Now both methods of pattern producing, viz., regroupings of pigments and loss of pigment, may be found at the same time in one individual, giving rise, of course, to a variety of colours in the plumage. The method of dispersal of these colours has been suggested by Allen.

His idea is, and it is based originally on Professor Castle's study of variegated guinea-pigs, whose monotone ancestors are still abundant in a wild state in South America, that there are definite areas of the body which though contiguous, are independent of each other in their pigment-producing activity ; that is, in short, that the pattern is produced from a number of independent centres, which are fixed.

There is no need to recapitulate the arguments by which he arrives at his results, but he defines five, paired pigment areas on the body of a bird or mammal and a single unpaired area on the forehead. Each area has a definite centre from which pigment disperses ; when the centres are fully developed the animal is completely pigmented ; when none is developed, the animal is an albino. When the centre is only partly developed, the unpigmented portion remains white. Now it must be remembered that the argument is based on a study of domesticated animals—dogs, cows, horses, mice, ducks, etc.,—in which colour is not stable. In translating the theory to terms of stable colouration in wild species, we have got to understand that the dispersal of pigment in the pigment areas (then known as 'pattern') has been fixed like any other heritable characteristic by natural selection. That it has not been immutably fixed is shown by the constant individual variation that we find in a species, and the great individual variation that we find in patches of white, such as the speculum of a shrike, is greatly in favour of the theory.

The arrangement of the pigment areas in a bird is best seen in the accompanying figure. It will be remembered of course that long feathers must be considered in terms of origin of their bases and the modifying influence of pterylosis (arrangement of feather tracts) must also be borne in mind.

According to Allen's theories, pigmented colouration and the resulting pattern starts independently in each of these centres. Where strong, it covers the whole centre ; where weak, the paler portions are on the periphery, in extreme cases being albinistic. Such a white patch is termed a ' primary break.'

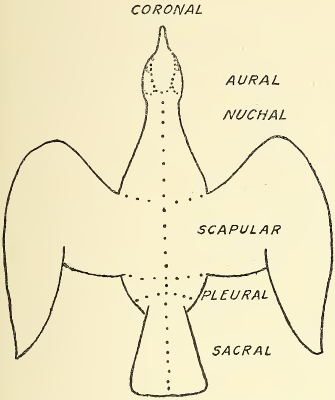


FIG. 1. Distribution of pigment centres in a bird.

It is well known that contrasting patches of colour in a bird's plumage tend to follow very similar lines, even in quite unrelated families. The presence of a pale supercilium, a dark stripe through the eye, a moustachial streak, a pale rump patch, pale outer tail feathers are recurring details that immediately occur to the mind. Study the diagram of Allen's pigment centres and you will observe how these recurrent types of pattern agree with his theory that pale patches occur at the limits of the pigment centres, remembering of course that the boundaries extend to a central ventral line on the bird.

In Fig. 2 we have a side view of a bird's head with the divisions marked in by dotted lines. It will be at once seen that the superciliary stripe occurs along the junction of two areas, ending where they end. A moustachial streak coincides with the junction of the ear patch and the neck patch. A pale forehead patch and a pale chin (two equally common features) represent the extremities of their respective pigment areas. The pale circle of feathers round the eye in some species would represent an extremity area within the ear-patch. A white rump patch is considered as representing a junction of the pale extremeties of the two dorsal patches, which at their other extremeties produce a pale abdominal patch.

As examples of how pattern is produced by primary breaks, Allen quotes two familiar birds, the Mallard (*Anas platyrhyncha*) and the Cotton-Teal (*Nettopus coromandelianus*). The white ring round the neck of a mallard drake is a primary break between the neck and the shoulder patch, a crystalized patch of incipient albinism in other words. In the Cotton-Teal this albinism has advanced to such an extent that merely a little pigment is left, giving the effect of a white neck with a black ring. In this bird the black crown patch is fully pigmented and defined, the albinism having covered the whole of the ear-patches. The instability of white in the neck patches of the *Anatidæ* is evident from several species of geese.

Attractive as such theories are, too much reliance must not be placed on any one of them alone. The whole of Nature is dominated by a net work of interlacing causes and results, and a theory of pigment dispersal to form patterns, however true, must be also subordinate to the needs of other dominant factors. For instance, a pattern produced by primary breaks of white patches must have or have had a definite survival value. It must not be inimical to the species by making it too conspicuous and prejudicing its chances of safety unless some other factor like intelligence allows it to be conspicuous with impunity as in the case of ravens and swans. The æsthetic values of sexual display, the influence of climate and terrain and a host of other considerations war together for their influence on this and every other aspect of a bird's life.

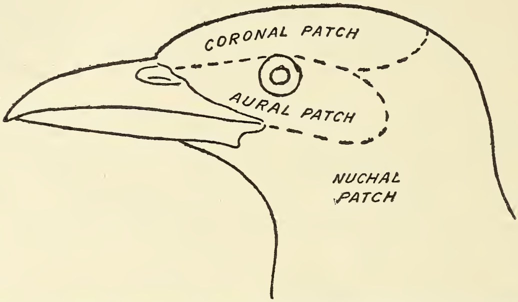


FIG. 2. Head of a bird to show how pigment centres affect pattern.

That the colour patterns of a bird's plumage have been developed gradually, does not admit of doubt. Once we admit the development of the bird from the reptile, the development of plumage and of the multifarious patterns that we see around us follows automatically. Whilst many species let us see the lines which it has followed.

Such examples fall under three main headings—

(1) In some species, such as the Gulls (*Larus*), although in the adult the sexes are alike, each individual passes through a number of definite stages from the immature to the fully adult plumage.

(2) In some species, such as many of the Redstarts (*Phœnicurus*) and the Rose-Finches (*Carpodacus*), the adult male and female are unlike, but the male reaches his adult plumage through the female plumage. That is to say in his own person he recapitulates the stages of plumage development of the species. In such cases both sexes pass through a similar juvenile plumage and then assume a second plumage in which both are absolutely alike. The

female remains at this stage, the male finally assumes a special breeding plumage; this may be retained permanently or in some cases, such as the Weavers (*Ploceus*), merely for the duration of each breeding season.[1]

(3) In some families and genera such as the Orioles (*Oriolidæ*) and Paradise Flycatchers (*Terpsephone*) different species may recapitulate in their peculiar plumages the stages of development reached by the group as a whole. In other words the immature plumage of one species is the mature plumage of another. A very striking example of this is also found amongst our Indian Cuckoos where the Banded Bay Cuckoo (*Penthoceryx sonneratti*) remains, when adult, in a plumage virtually the same as the immature plumages of the other Cuckoos (*Cuculus* and *Cacomantis*).

Now insects and birds share this in common, that they are the creatures of intensest life and of most intense colouration and there is possibly some connection between the two facts. For bright colours may have something to do with rapidity of metabolism, that is, they may be the waste—or rather by-products of intense living. We are accustomed to think only of colour and pattern in external terms, their effects on the visual perception of others. But the possibility of other meanings of colour, such as metabolism, is evident from cases amongst the mollusca where the brightest irridescent colours are often found on inner surfaces that never see the light at all during the possessor's life-time. It is a platitude that the most gorgeous birds are the product of tropical countries, and this is ultimately due to temperature. Just as the steaming jungles of the prehistoric world produced a grossness of size and form amongst the prehistoric monsters, so do the tropical countries of to-day produce a luxuriance of food and heat and light which express their super-abundance in the plumage of the birds under their influence; there are waste-products to spare and use in directions that to the human, and probably also the avian eye mean beauty rather than utility.

It is of course well-known that there is a direct connection between all living creatures and their environment. The general lines of the agreement are well known, and in numberless species, it is expressed by their division into geographical races or sub-species. It is for this reason that the sub-species of Indian birds follow fairly-defined lines. Himalayan species, as a rule, have an eastern and western race, meeting about Nepal, the eastern race being generally darker and smaller. In the Indo-Gangetic plain there may be eastern and western races, the eastern race again being smaller and darker. The Peninsula is generally responsible for a richly-coloured race, grading into the eastern Indo-Gangetic race on the one hand, and the Cingalese race on the other. Humid areas produce dark birds, desert areas pale birds. North and west enlarge, south and east dwarf their birds.

The reason why this should be so, is fairly self-evident, as we see the same connection all over the world in all classes of Nature.

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[1] The theories regarding the development of special male plumages will be noticed in a later chapter.

The ultimale causes are temperature and humidity affecting and working through numerous factors that directly and indirectly affect the living creature, be it man, animal, bird or insect.

Now this point cannot be considered apart from the great and oft-debated subject of 'Protective colouration', a most engrossing theory which has probably been far too strongly insisted upon and which has undoubtedly in consequence obscured an appreciation of the true explanation of many aspects of colouration and pattern. This theory must be considered here at some length.

The basic point of the theory of Protective Colouration is very easy to understand—that a living creature, be it bird or animal or insect, is coloured (and sometimes colouration is aided by form and behaviour as well) in such a way as to blend with its surroundings and so escape the notice of its enemies. It is accounted for by that evolutionary progress known as natural selection. A simple example to make this clear, is afforded by a moth.

Many species of moths are accustomed to spend the hours of daylight resting with wings outspread on the trunk of a tree. Their wings are so coloured that they blend absolutely with the surface on which they rest, and an untrained human eye is unable to see them until a chance movement makes them take to flight. The resemblance of the moth to the tree trunk is often very striking, reproducing apparently the lichens or fungi on the trunk or the furrows of the bark. The moth at rest on the correct surface is invisible, or more correctly speaking its identity is temporarily merged with that of the trunk. About the fact there is no doubt. Two questions however emerge: is the moth conscious of the resemblance and does it deliberately profit by it? and how was the resemblance originated?

Now this example, albeit a very perfect one, is a very simple one. The forms of Protective Colouration recorded are very abundant and often very complicated and often depend for their success on curious and complicated behaviour on the part of the wearer. In our example however a very simple theory appears to explain the facts. The theorist says that the species in question adopted the habit of resting on tree trunks; every individual of the species varies very slightly. In generation after generation these variations were worked on by Natural Selection; that is to say that the individual whose wings resembled the trunk, was less likely to be eaten by the wandering tit or spider than the one whose colour was a trifle more conspicuous. The survivor transmitted his characteristics; the moth whose colour was conspicuous, did not survive to hand his characters on to another generation. A similar pruning process eliminated the individuals who perched elsewhere than on tree trunks. The final result is seen in the perfect resemblance, variations from which are still being ruthlessly cut away by Nature.[1] Here there is no need to suppose that the moth is conscious of its disguise. The habit and mode of life of the species has unconsciously developed the disguise which as unconsciously profits it.

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[1] It is only fair to remark here that many students deny the possibility of the inheritance of variation.

Stated in simple terms like this, the theory of Protective Colouration as produced by Natural Selection is very satisfactory and very fascinating. The enthusiastic believer immediately starts on the quest for more examples and finds them on every side in every degree of development and perfection. That there is a great deal of truth in the theory can, I think, hardly be doubted. But an examination of the facts shows that too much weight must not be placed upon it.

Protective Colouration, according to the believers in the theory must be considered under three forms :—

(1) Obliterative Colouration.
(2) Protective Colouration proper.
(3) Mimicry of other species.

Obliterative Colouration is certainly the most universal of the three and yet it is the least often recognized and stressed; but it will be more readily appreciated by the student in the post-war world than by those who worked at the beginning of this century. Its aim is not to imitate surroundings but to destroy shape and substance; to cut up the figure of the bird or insect so that the observer sees not a bird, but a series of disconnected colours which convey no message to the brain in the general blend of colours and lights that make up any foreground. An easy example is the Red-wattled Lapwing (*Lobivanellus indicus*), the well-known 'Did-he-do-it' of Anglo-India. Stand a specimen on a museum shelf and you will think what a conspicuously coloured bird it is; stand it in the varied lights and shades and objects of its habitat and so long as the bird is motionless your eye will pass over it a dozen times before your brain realizes its presence. It is the principle of dazzle-painting.

Protective Colouration proper is the best-known form of all in which the bird, the egg or the chick resembles the surroundings of its habitat or some object in them. It too is very common.

All our Indian Nightjars (*Caprimulgus*) afford most perfect examples of this type of colouration. In each species the same type of pattern runs with slight individual modifications. The colour is a mixture of greys and browns, diversified with black and buff markings, so that the plumage of the bird exactly harmonizes with the surface of bare dry ground and the vegetable rubbish that lies upon it. The Nightjar spends the hours of daylight—for it is in habits a nocturnal bird—dozing on the ground and it blends so perfectly with its surroundings that it is almost invisible. As if conscious of the perfection of its disguise it is very loath to move, only springing up into the air when the observer is almost upon it. On the ground it sits motionless, never travelling on its feet. Some species live in the open, others in forests and the majority in scrub jungle, but the colouration suits all types of ground and is modified in connection with them.

So far as I am aware, none of our Indian Nightjars nor the allied Frogmouths (*Podargi*) support the implications of their plumage by any specialized behaviour. But in Trinidad there is a curious Nightjar (*Nyctibius griseus*) whose nesting habits were described with photographs in the *Ibis* 1925, p. 654, *et seq*. This bird places its solitary egg in the decayed stump of a tree, where a small hollow just holds the egg. The bird broods the egg sitting in a perpendicular position, the head held stiffly upwards, the tail straight downwards pressed against the outer surface of the trunk. In this position the markings blend with the stump so that the perpendicularly sitting bird (and it will be remembered that most Nightjars brood in a normal horizontal attitude) becomes a continuation of the stump. To heighten the delusion, the bird draws in the skin of the gullet and keeps the large dark eyes all but shut, peering out through a mere slit between the lids. Here colouration is reinforced by behaviour.

Such a reinforcement is not uncommon. Well-known examples are found in the case of the Wryneck (*Iynx torquilla*) which writhes its head and neck in a snake-like manner agreeing well with the snake-like markings on their upper surface, and in the Little Bitterns (*Ixobrynchus*) which are said to stand motionless in a reed bed with head, neck and beak pointing stiffly upwards so that the long-pointed shape and the streaked markings of those parts blend with the surrounding reeds.

The third form of mimicry is most familiar amongst insects but a few cases are believed to occur amongst birds. In this form of colouration one species resembles another species very closely and the explanation given is that it derives some advantage from being mistaken for that species. For instance an edible butterfly of one family may be practically indistinguishable in appearance from an inedible butterfly of another family, inedible that is from its bitter taste.[1]

The standard examples of this mimicry in birds are found in the family of the Cuckoos (*Cuculidæ*). In India we have two perfect examples in the Drongo-Cuckoo (*Surniculus lugubris*) which can easily be mistaken for a King-Crow or Black Drongo (*Dicrurus macrocercus*) and in the Hawk-Cuckoos (*Hierococcyx*). In the latter, not only do the adults resemble, in build and plumage, hawks, but their juvenile plumage also resembles the juvenile plumage of hawks.

These three types of colouration might easily be illustrated with a wealth of examples which would make most fascinating reading. Imaginative writers, amongst them numbered several well-known names, have dilated on the benefit to the cuckoos of the mimicry when laying their eggs in other birds' nests, but unfortunately such accounts cannot be accepted by any one who knows in life the species concerned.

The primary consideration in examining the theory of Protective Colouration is to ask oneself the nature of the dangers against which colouration has been evolved to protect the wearer. The danger in such cases must have been from some living enemy, not an inanimate one, and it must have been fairly constant or it could scarcely have had any evolutionary value. In many instances, of course, the enemy may have been of a type no longer of importance in the life-economy of a species. The first point to insist on, is the elimination of the human element. It is impossible to believe that man has had much influence on the evolution of Protective Colouration. These changes took place at a period in the world's history when man was far from dominant in the world as he is now. Man himself was in a very primitive stage, hunted as much as a hunter, and with a brain very deficient in reasoning power. His numerical abundance was far less than it is to-day. In the dense tropical forests and the deserts where so many of the finest examples of Protective Colouration occur, man is still fairly negligible.

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[1] There are however grave difficulties in the way of the acceptance of this explanation of mimicry in butterflies as Professor Punnet has shown in his interesting book on the subject.

The birds of the desert are commonly cited, as a class, as one of the outstanding examples of Protective Colouration. What are their enemies against which their colour is presumed to be a protection ? Man there as an enemy is negligible, until he provides himself with a gun or a trap. The gun or even the bow and arrow is too modern to count. Colour never saved anything from an inanimate trap. Mammals, other birds, snakes and possibly lizards appear the only potential enemies in the desert. Yet I do not feel that colour was evolved as a defence against any of them, and they in their turns also wear the desert livery. The mammal hunts as much by smell as sight. The bird of prey has far too keen an eyesight to be deceived by sandy colouration if the bird is moving. And if the bird is still, its colour is negligible. Any field naturalist and sportsman knows how little notice a wild thing pays to a stationary object, however little it assimilates with its surroundings. Snakes and Lizards may be serious enemies to eggs and young, but can scarcely be of dominant importance to the volant bird.

Now it is extremely probable that the term Protective Colouration is an entire misnomer as applied to the sandy-coloured forms of Desert life. Dr. P. A. Buxton has examined the whole question in his interesting book on '*Animal Life in Deserts*,' pointing out, amongst other difficulties, that the alleged Protective Colouration is common amongst many insects and mammals that either live underground or are entirely nocturnal, circumstances that would certainly rob their colour of any value ; that numerous desert creatures are not protectively coloured at all, as for instance, several beetles that are deep black and various wheatears which are conspicuously pied black and white.

The most conclusive argument is, however, supplied by the small mammals. It is a fact that desert species and sub-species differ from their near relatives from other environments just as much in their pale ventral surface as at their buff or sandy backs. The pale ventral surface is often more enlarged up the flanks of a desert mammal than it is in its relatives from other environments. This paleness of parts of the animal which cannot normally be seen even extends to the soles of the feet. The soles of the feet of desert door-mice, to quote from Sumner, are nearly or quite lacking in pigment, while those of mice from the more humid coastal regions vary from purplish to nearly black.

It is much more probable that the explanation of the sandy colouration of desert creatures must be sought elsewhere, either due in some way to dessication or the reverse of the well-known fact that humidity produces an excess of pigment and therefore darker colouration, or to some quality of what for want of a better name may be called natural photography. By this, I mean a certain sensitiveness of the pigments to their surroundings, the key to which may be sought in the reflex actions of the chameleon whose colours change according to its immediate environment. Such a change would not be inimical to the species, in fact in numberless independent cases, it would prove of definite value and so would be encouraged by those factors of evolution which alone would not have been potent to produce it.

Just as Desert-forms are quoted by the keen evolutionist as outstanding examples of Protective Colouration, so are Alpine and Polar species regarded by him as another manifestation of the same cause and effect. And very fascinating it is to connect a white plumage with Protective Colouration in the snow, the more especially when it is assumed by a seasonal change. But here too, it is probable that protection is merely a subsidiary result of the assumption of white plumage, and it is noticeable that in the Himalayas with its vast areas of snow we do not find any examples of white-plumaged birds. Such forms should be regarded as purely Polar in origin.

It may here be mentioned that desert and Alpine forms are sometimes regarded as unsuccessful species in the struggle for existence, the theory being that they retreat to these inhospitable conditions to avoid competition with more dominant forms. Competition amongst closely-related forms is hard to realize as we usually see it only in its after-effects, namely distribution. Amongst common birds in India, I would cite the Jungle-Crow and the House-Crow, the Jungle Babbler and the White-headed Babbler as two conspicuous pairs of rivals. Similar pairs of rivals may be found amongst mammals, such as the two palm squirrels and various rats. Now in both cases the rivals have a wide distribution together, looked at in terms of distribution as broadly defined in the manuals; but I believe that an accurate knowledge of these birds will show that their ranges are not as coincident as at first sight appears. All down south-eastern India, for instance, although the Jungle-Babbler and the White-headed Babbler appear to inhabit the same area, it will be found that the country is broadly speaking divided between them. The Jungle-Babbler acts up to its name. The White-headed Babbler is the dominant form in the immediate vicinity of man. The unconscious support of man, in other words, enables the White-headed Babbler to exist within the territory of what would be otherwise a dominant, all-conquering form.

This is very clearly the case as between the two Crows and it helps to explain the complete domination of the Jungle-Crow throughout the sparsely-inhabited Himalayas where we find isolated and small colonies of House-Crows living in places like Srinagar and Simla where they clearly live under the ægis of man. If man deserted the Vale of Kashmir, I am certain that the House-Crow would vanish too. For it is remarkable that the House-Crows there belong to the pale desert form of the Punjab and Sindh *Corvus* *splendens zugmayeri* which has obviously travelled up along the trade routes in comparatively modern times. Were the House-Crow an indigenous form, it could not, by every law and effect of climatic variation, have been the same in plumage as the bird of lower Sindh.

Now in England the competition between related forms is seen very clearly in the case of the Crows, for the Jackdaw is almost certainly the influence which is gradually driving westward and finally exterminating the Red-billed Chough. The latter was known to have been common in the coastal cliffs of England as far eastward as Kent and Sussex as late as the eighteenth century. Now it has almost vanished from even Cornwall.

This explains why the Chough throughout its vast range is largely a mountain species. The stronger Crows have driven it slowly from the most favoured areas, as the Jackdaw is driving it from England. Altitude cannot be the deciding factor for a bird that is equally at home in the sea-cliffs of England and Spain and the mountains above 10,000 feet. Whilst we see also that in Europe the Red-billed Chough has driven the weaker Yellow-billed Chough into the more barren heights above it. The same relationship between the Jackdaw, Red-billed and Yellow-billed Chough can be perceived in Kashmir, though not so clearly in a luxuriant country where competition is not so severe between the three species.

One aspect of the subject of Protective Colouration remains to be considered in detail, that is, the cases in which colour and pattern are apparently reinforced by behaviour. Such cases are very hard to understand whatever one's own attitude towards the subject. They are most common amongst insects but there are some cases amongst birds, though not, I think, as many as enthusiasts for Protective Colouration would have us believe. The most striking example I ever met with personally was at Ludhiana. Passing a tamarisk tree I noticed a mass of the peculiar curly droppings which give away the site of a dove's nest or roosting place, a sight which is familiar in India. I naturally investigated but found nothing to account for the droppings and then I suddenly realized that they were all caterpillars. Each caterpillar in itself was a perfect imitation of a dropping ; each caterpillar was lying curled in the manner necessary to complete the resemblance. While the social habit of the caterpillars and the manner of their dispersal on the tamarisk provided the finishing touch.

Now amongst birds, the standard example of complementary behaviour is that of the Bitterns, who stand rigid amongst the reeds, with neck and head and beak pointing stiffly upwards, shape and markings obliterating the bird in its surroundings. Hudson's classic description of this behaviour in a bittern that he wounded in La Plata, would seem to set the matter beyond all doubt. When we read how the bittern continuously turned so as to keep the most suitable aspect of its form towards Hudson we can hardly escape the conviction that the bird knew exactly what it was doing. Yet even here, as undoubtedly in many of the stock examples, there has been a misinterpretation of the facts.

Readers of the *Journal* will remember in vol. xxxiii, p. 657 an extraordinarily interesting article by Capt. R. S. P. Bates on ' A

Reed-bed in the Dal Lake, Kashmir' with its studies of the Little Bittern (*Ixobrynchus minutus*) at the nest. One of the photographs show the Little Bittern on its nest in a position in which it resembles a reed. The photograph is reproduced on the opposite page. Hold the plate a little distance away and the bird blends very well with its surroundings. Surely the true explanation lies in the accompanying passage :—' During the time he was incubating, he was never still but forever looking this way and that for possible enemies. At every sound he assumed what I came to call the "on guard"[1]; neck outstretched and bill forming one line with it, obviously ready to impale upon its sword-point any intruder with which he could contend. Should a kite or crow pass overhead, with amazing speed his bill was pointing skywards with his neck stretched to impossible limits.' Combine the 'on guard' movement with the instinctive habit to 'freeze' at the first sign of danger, and remembering that a bird on guard ready to strike at an intruder would naturally always face in the direction of danger, you will surely have a sufficient explanation of the Bittern's behaviour without assuming that it is intended to support its colouration. The fact that the Bittern is striped, is not as important as it looks. Only the female Little Bittern has the striped neck; had it been spotted or indeed any pattern at all we could still have explained that it was meant to agree with the medley of light and shade in a reed bed, an explanation which in any case has to be applied to the male, who incubates in turn with the female and has no appreciable difference in habits.

Similarly with the Wryneck (*Jynx torquilla*). The agreement between its snakelike colouring and the snake-like contortions of its head and neck are another oft-quoted example of Protective Colouration backed by behaviour. 'The undulating motions of the bird, dimly seen in the gloom of its retreat [in the nest-hole], with the loud hissing noise that it makes, are almost always enough to scare even a marauder of experience; for they never fail to suggest, as is doubtless their intention, that the hole into which he is about to thrust his hand has a snake for its tenant' (Yarrell). There is no question about the curious behaviour of the bird, to which its name of snake-bird in many countries of the world is due. A wounded bird that I picked up in the Jhang district treated me to a similar exhibition of curious writhing of the head and neck as I held it in my hand. But surely it is only the human brain that connects the hissing and writhing and colouration together as the imitation of a snake. Hissing in a nest-hole is a common manifestation of a mixture of fear and defiance found in many other species. The Tits for instance are well-known to behave in this manner but neither their colour nor their movements suggest the idea of a snake. As for the Wryneck's writhing movements they fulfil rather the popular, than the natural idea of a snake's behaviour. I personally have seen thousands of living snakes and do not once recall movements similar to those of

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[1] I do not think Capt. Bates intends all the implications of his military metaphor.

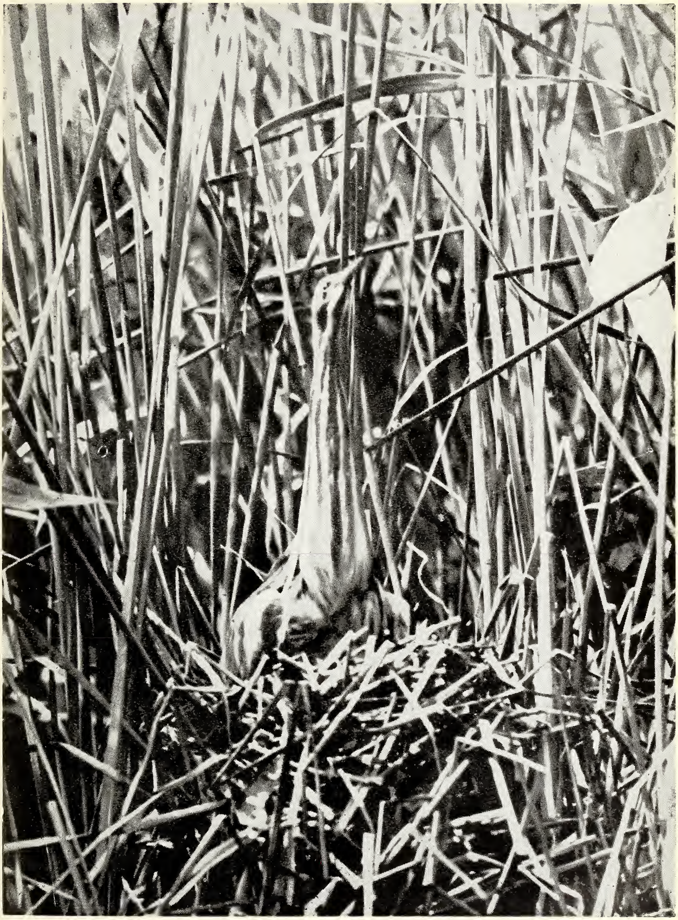


Photo by Capt. R. S. P. Bates.

The Little Bittern (*Ixobrychus minuta*) on its nest.

the Wryneck. While as for the Wryneck's colouration, it might with far more justice be considered protective colouration in several other ways than resemblance to a snake.

In estimating the truth of theories such as this, one needs to be very certain that the facts are correctly stated. An attractive instance is copied from book to book without any attempt to corroborate or test its correctness. The Hoopoe (*Upupa epops*) for instance is credited with this extraordinary behaviour. To quote Pycraft, 'Even birds of striking coloration, such as the Hoopoe contrive to mask their presence when threatened. The Hoopoe at such times, throws itself flat upon the ground, and simultaneously spreads out the wings. As a consequence it looks so little like a living animal that it secures escape where escape seems impossible.' Elsewhere I have seen it credited with the desire to look like a bundle of old rags lying on the ground. This may be so; but my only comment is that I have seen innumerable Hoopoes, mostly in India but also in Southern Europe. I have never seen this wonderful behaviour. I have seen Hoopoes hawked and then they always placed more reliance on their marvellous ability to dodge in the air than on any resemblance to a bundle of rags. Once indeed I did see a Hoopoe in a semi-recumbent position on a roof, his feathers negligently spread so that to a human eye he did look a curious object. But he was obviously only sunning, like any lazy hen.

This chapter grows over long, so I will close it with a confession. I had looked forward to writing it as the most likely to be interesting to readers of the *Journal*. My mind's eye glanced at the fascination of innumerable recorded examples of Protective Colouration and I thought how interesting they would be to record and illustrate. The traditional explanations of the Cuckoos' hawk-like plumage, the green Pigeons in the Peepul tree, the flowers on the head of the leaf-green barbets, the bare eye patch of *Thereiceryx* resembling the fruits on which it feeds, the double-face of the Pygmy Owlet (*Glaucidium brodei*) would all weave into a tale of wonder on the most popular lines. I started the chapter and wrote a dozen pages: but old of-recurring doubts returned and strengthened. The pages were torn up and what I have written is merely intended to stimulate the readers of the *Journal* to study the question anew with the wonderful Indian Fauna before them, examining each case in its merits with observation and thought combined. Protective colouration certainly exists but it has been as certainly overstressed.

(*To be continued.*)

THE MALARIA PROBLEM IN BOMBAY.

BY

Major G. Covell, M.D., D.Ph., D.T.M. & H., I.M.S.

(*With a map.*)

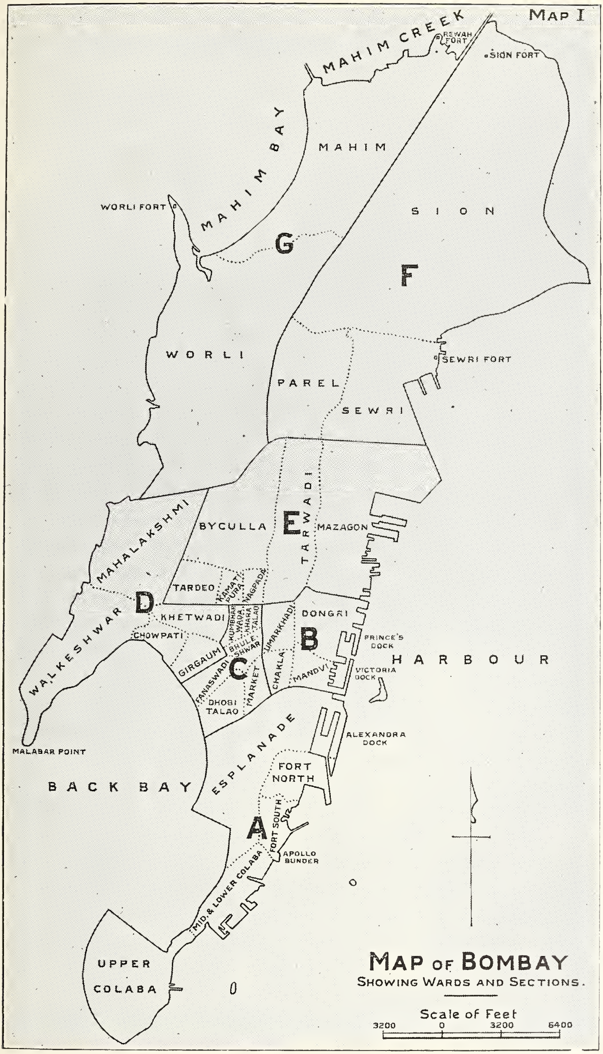
The History of Malaria in Bombay.

Malaria has been prevalent in Bombay from very early times, but until the year 1908, no systematic investigation as to its causation was carried out. In that year the incidence of the disease was very severe in the City, especially in the neighbourhood of the Alexandra Dock, which was then in course of construction.

In September 1908, a most important paper was read before the Bombay Natural History Society by Captain W. G. Liston, I.M.S. (4), in which he recorded the fact that 25 per cent of the specimens of *Anopheles stephensi* caught in the vicinity of the Dock and dissected by him were found to harbour malaria parasites. This was the first occasion on which this species (now known to be the principal carrier of urban malaria in India) had been found infected in nature.

From 1909 to 1911 a systematic malaria survey of the whole Island was carried out by Dr. C. A. Bentley, in the course of which Liston's incrimination of *A. stephensi* as the mosquito vector of malaria in Bombay was abundantly confirmed. Bentley showed that the outbreak of 1908 was due to the existence of numerous permanent breeding-places of this species in the City (chiefly house-wells), coupled with the presence of a large labour force engaged in the building of the Alexandra Dock and the production of innumerable temporary breeding-places during its construction. A very interesting article by Bentley, entitled 'The Natural History of Bombay Malaria' appeared in this *Journal* in October, 1910 (1).

In the report which he submitted at the close of his investigation (2), Bentley put forward detailed proposals for dealing with the breeding-places of *A. stephensi* and thereby eradicating endemic malaria from Bombay. A Special Malaria Department was created, and a certain number of Bentley's proposals were carried out, in spite of considerable amount of apathy and even active opposition. The Department was however abolished in 1918. During the time when it was in existence, the incidence of malaria in Bombay was greatly diminished, but soon after its abolition the disease again began to increase. As had been the case in the previous outbreak, there were a number of severe attacks of malaria among the crews of ships which had been berthed in the harbour, whilst the amount of malaria in the city resulted in the disorganization of business to a serious extent. In June 1922, the heads of about 40 commercial houses in the Fort area sent in a petition to the Corporation, drawing their attention to the grave increase of the disease in their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ALEXANDRA DOCK
MALABAR POINT
FORT NORTH
BACK BAY
FORT SOUTH
A
APOLLO BUNDER
MID. & LOWER COLABA
UPPER COLABA
MAP OF BOMBAY
SHOWING WARDS AND SECTIONS.
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The Malaria Problem in Bombay

neighbourhood, and complaints of malaria among the staff of St. George's Hospital, who had suffered very severely from the disease in the 1908 outbreak, were again received.

In 1923 the Malaria Department was reconstituted, but malaria continued to be severe until 1925. In the two following years there was an appreciable diminution in the incidence of the disease, but the reports of the Executive Health Officer showed that it was still widely prevalent in the city.

In 1928 the present writer was deputed to investigate the position, and a six months' survey was conducted from March to September of that year.

Results of the 1928 Survey.

The writer's investigations (3) confirmed the findings of Liston and Bentley with regard to the insect vector of malaria in Bombay, but the distribution of the disease was found to have changed very considerably during the 17 years which had elapsed since the latter presented his report.

In 1911, apart from minor foci in the vicinity of Malabar Hill and Bhandarwada reservoirs, the main distribution of the disease was practically limited to A, B and part of C Wards, the area of greatest intensity being in Esplanade, Fort North and Mandvi Sections, in the vicinity of the Alexandra Dock. Malaria was almost non-existent in the northern half of the Island, i.e., in Mahim, Sion, Worli, Parel and Sewri Sections.

In 1928 it was found that although the disease was less prevalent than formerly in the southern part of the City, it had now become very much more widely diffused, the most severely affected parts of the Island being the areas in which most of the mills were situated, i.e., Worli, Parel and Byculla Sections. The extreme north of the Island, which is subject to extensive flooding during the monsoon, remained, as in Bentley's time, practically free from malaria.

In order to understand how this change in the distribution of the disease has come about, it is necessary to give a brief account of the Anopheline mosquitoes of Bombay, and in particular, of the habits of *Anopheles stephensi.*

The Anopheline Mosquitoes of Bombay

Eleven species of *Anopheles* have been recorded in Bombay, namely, *A. subpictus* (' *rossii* '), *A. stephensi*, *A. vagus*, *A. culicifacies*, *A. listonii*, *A. barbirostris*, *A. jamesii*, *A. fuliginosus*, *A. pallidus*, *A. moghulensis* and *A. tessellatus*. Of these, only *A. subpictus* and *A. stephensi* exist in sufficiently large numbers to exert any influence in the transmission of malaria, the remaining species being so rare as to be of interest only to the entomologist.

A. subpictus, which is by far the most common Anopheline in the Island, has never yet been found naturally infected in India except on one doubtful occasion, although many thousands of specimens have been dissected in various parts of the country. It occurs all over the Island, the larvæ being found in collections of water of every description, and it is present in large numbers in localities where malaria is practically non-existent. This species may be dismissed as a possible vector of malaria in Bombay.

A. stephensi is the one malaria-carrying Anopheline in India which is able to adapt itself to the conditions obtaining in cities. It is generally regarded as being one of the most important malaria-carriers in this country, and is notorious as being pre-eminently the well-breeding Anopheline of India, the larvæ having been found in the wells in Delhi, Calcutta, Madras and numerous other localities throughout India.

This species prefers fresh water, constantly renewed, for its breeding-places. It does not normally breed in foul or stagnant water, thus differing conspicuously in its habits from the harmless *Anopheles subpictus*, and from the Culicine mosquitoes whose attacks cause such bitter complaints from many of the residents of Bombay. Hence the foul-smelling open sewers of the Island, however unpleasant and harmful they may be in other respects, have no bearing on the malaria problem. Similarly, stagnant swamps and natural ponds are of practically no importance in this respect. For instance, Dharavi village, which is surrounded by ponds and swamps, is almost entirely free from malaria.

A. stephensi will breed with equal facility in dark places and in those exposed to direct sunlight, and the larvæ will flourish in any depth of water from a fraction of an inch to 20 feet, or indeed probably to any depth. The breeding-place may be situated below the level of the ground, or on the roof of a building 80 or 100 feet high, and the water in which the larvæ are found may be cold, as in wells, or warm as in the case of roof cisterns exposed to the blazing sun. Frequent disturbance of the water, such as is produced, for instance, by drawing water from a well by means of a bucket, will not prevent breeding. In order to reach its breeding-place, *A. stephensi* requires only the narrowest of openings through which to pass.

In the case of Bombay, thousands of breeding-places exist which fulfil the above conditions, all, be it noted, provided by man. The most important of these are :—

(i) *Permanent Breeding-places*, i.e., those which are in existence at all times of the year, such as wells, cisterns, fountains, garden tanks and tubs, water used in building construction, cellars into which subsoil water percolates, leakages from reservoirs, etc.

(ii) *Temporary Breeding-places*, formed only during the rainy season, such as collections of water in improperly graded roof-gutters and terraces, disused tins and other receptacles, ill-drained yards and vacant building plots, hollows in machinery and scrap-iron, unfinished and abandoned buildings, cellars which become flooded during the monsoon, etc.

An important point brought out by Bentley, and confirmed by the present writer, is that the larvæ of *A. stephensi* usually only occur in temporary pools and collections of water when permanent breeding-places of this mosquito exist in the immediate neighbourhood. It is for this reason that the control of malaria in Bombay depends on the eradication of the permanent breeding-places of this species.

The malaria caused by the presence of *A. stephensi* in cities is extremely localized, the reason being that its breeding-place is usually situated within the house, i.e., in the same building as its food-supply. When conditions become especially favourable for transmission of malaria, e.g., a combination of suitable meteorological conditions, the introduction of a body of labourers with their families and the production of numerous breeding-places during building construction, a more generalized outbreak originating from these localized foci is likely to result.

Reasons for the Persistence of Malaria in Bombay, and for its Changed Distribution.

We are now in a position to discuss the reasons why malaria continues to exist in Bombay, and why the distribution of the disease changed so markedly during the 17 years which elapsed between the surveys of 1911 and 1928.

In 1911 there were 4,380 wells in the Island, of which 3,280 were located in the southern half. A very large proportion of these were situated within the houses, and out of 4,000 wells which Bentley examined, 1,200 were found to contain larvæ of *A. stephensi.* These formed a permanent source of breeding, and the numerous temporary collections of water formed during the construction of the Alexandra Dock provided additional breeding places, which, together with the presence of a large labour force, no doubt played a very large part in the incidence of the 1908 outbreak.

By 1928 the number of wells in the southern half of the Island which were not either filled in or hermetically covered, had been reduced by some 50 per cent, but there still remained a sufficient number to provide a nucleus for the spread of malaria whenever conditions should become especially favourable. The presence of a considerable labour force engaged in building construction on the Ballard Estate undoubtedly played a part in the increase of malaria incidence which occurred in the period 1918–1925.

As regards cisterns, in 1911 the total number in the Island was 4,887. In 1928 there were no less than 25,846, and the number was increasing year by year with the expansion of the water-carriage system of conservancy. Most of the large overhead cisterns in connection with mills and railways were without covering of any sort, or were provided with corrugated iron covers with numerous openings in them through which mosquitoes could pass. A considerable proportion of the remaining cisterns, which were for the most part situated on the roofs of houses were found to be non-mosquito proof. In addition to these there were a very large number of small cisterns in connection with the automatic flush system which had been installed in the various public conveniences situated in different streets in the City, and in mill compounds, etc. These are seldom, if ever, mosquito-proof and frequently contain the larvæ of *A. stephensi.*

Another additional source of breeding of *A. stephensi* in Bombay was provided during the construction of cement-concrete buildings. This species was found to breed freely in the water with which the surface of the cement-concrete was covered whilst it was setting.

A large number of these buildings have been constructed in Bombay in recent years, and must have resulted in the production of an enormous number of *A. stephensi.*

The increased facilities of communication, the northward shift of the population, and the presence of a large encampment of labourers at Worli during the construction of various development works in that neighbourhood have also acted as contributory factors in the spread of malaria towards the northern part of the Island.

The Control of Malaria in Bombay

The propagation of malaria depends on the following factors :—

(i) The presence of a human reservoir of infection, i. e., persons with a sufficient number of sexual forms of the malaria parasite in their blood to infect the mosquito.
(ii) The presence in sufficient numbers of a suitable Anopheline vector, and of the breeding-places which it requires.
(iii) The presence of a susceptible human population.
(iv) Meteorological conditions favourable to the life of the mosquito, and to the development of the malaria parasite within it.

The last-mentioned factor is present in Bombay for several months in the year, and cannot be modified.

Factor (i) will always be provided by the influx of infected persons from without. Theoretically it would be possible to stamp out malaria by the wholesale administration of some drug which would destroy all the parasites by a single dose. No such drug at present exists, and even if it were available, it is very improbable that the persons concerned could be induced to take it.

Factor (iii) will likewise always be present. It is not possible to hope that complete protection from the bites of mosquitoes can be achieved by the universal use of mosquito nets among the uneducated population. An improvement in the general economic condition of the people, better medical treatment and better education would however aid in the campaign against malaria.

There remains factor (ii), i.e. that of the Anopheline vector, which is open to attack. This is a problem beset with difficulties in rural areas, where natural breeding-places abound, and where there are often several species concerned in malaria transmission. In the case of Bombay, however, where there is only one vector, the breeding-places of which are exclusively created by man, it is possible to reduce the numbers of the species to such an extent as to bring malaria under complete control.

The measures recommended have been set out in detail in the report submitted to the Government of Bombay at the close of the 1928 survey (3), and will not be recapitulated here. There is no doubt that they could be carried out at a cost much less than the amount lost annually by the City on account of malaria from interference with labour, loss in wages and the provision of medical aid for the sick.

There are however certain grave obstacles to the carrying out of preventive measures in Bombay, among which may be mentioned the fact that various parts of the Island are controlled by different authorities, the lack of co-operation amongst these authorities, the religious and sentimental objections on the part of certain sections of the people to the closure of wells, and a deplorable tendency to drag matters affecting public health into the realm of party politics.

The only hope of complete success lies in the loyal co-operation of all the authorities concerned, and the better education of the people in matters relating to public health.

SUMMARY.

(i) Malaria in Bombay is transmitted solely by *Anopheles stephensi*, a mosquito which breeds in wells, cisterns, fountains, garden tanks and tubs, and similar collections of water, all of which are exclusively man-made.

(ii) These breeding places in 1928 were probably at least as numerous as they were at the time of Bentley's investigation in 1911, because (*a*) only a comparatively small proportion of those then existing had been eliminated, and (*b*) a large number of others, notably imperfectly protected cisterns, garden tanks, fountains, and breeding-places formed in connection with modern methods of building construction, had been created.

(iii) Whilst malaria in 1928 was less prevalent in the southern portion of the City than in 1911, the disease was found to have become much more widely diffused, the most severely affected part of the Island being now the areas in which most of the mills are situated. The reasons for this change in distribution are :—

(*a*) Increased facilities of communication between the south and north of the Island.

(*b*) The northward shift of the population. The population of Worli Section practically doubled itself during the period under review.

(*c*) The enormous increase in the number of cisterns in F and G Wards, from 92 in 1911 to 5257 in 1928.

(*d*) The presence of a large encampment of labourers at Worli during the construction of various development works in that locality, who suffered severely from malaria.

(*e*) The vast number of breeding-places which must have been created during the construction of reinforced concrete buildings.

(iv) Since there is only one species of mosquito concerned in the transmission of malaria in Bombay, and since the permanent breeding-places of this mosquito are exclusively man-made, it is believed that it would be possible to bring malaria in the Island under complete control by the adoption of a systematic campaign to eliminate all such breeding places or render them mosquito-proof. Success in this campaign can only be attained, however, by the active and loyal co-operation of all the authorities concerned.

(v) As long as permanent breeding-places of *A. stephensi* are allowed to exist, malaria will continue to persist in Bombay, because there will always be an influx of infected human beings from outside, and periodical outbreaks of a serious nature will continue to occur whenever local conditions become especially favourable for the spread of the disease.

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THE ORNITHOLOGICAL STATION AT HELIGOLAND.

A SHORT ACCOUNT AND SOME REFLECTIONS.

BY

SALIM A. ALI, M.B.O.U.

(*With four plates and a diagram*)

The rock-island of Heligoland lies in the North Sea off the mouths of the Elbe and the Weser, about 28 miles from the nearest point on the mainland. About half a mile to the south-east is the Dünen-Insel, or 'Dune Island', whose gently sloping beaches have made it such a popular sea-bathing resort that during the months from June to September, the population of Heligoland, normally about 2,000, swells up to 20,000 or more.

Dünen-Insel was connected with the main island till about the year 1720 when a violent irruption of the sea submerged the intervening neck.

In Summer, when the tide of visitors is at its flood, there is regular daily communication with the island by means of fast and luxurious passenger ships run by the Hamburg-Amerika Line, which take the pleasure-seeker across from Hamburg in six hours.

The main island is a barren rock, roughly triangular in shape, standing out of the sea with sheer rocky sides, about 200 feet in height, of a striking red colour. The top, or *Oberland* as it is called, is a beautiful grass-covered, green and undulating plain, broken up here and there by potato cultivation—one of the scanty natural products of the island. The red crags, the verdant *Oberland* and the shimmering white foam as the breakers dash against the foot of the rock, are said to have inspired the colours of the Heligoland flag which continue to-day as red, white and green. Philatelists will recall that these same colours also appeared on the much-prized old Heligoland stamps.

As recently as 1890, Heligoland was a British possession, having been acquired from Denmark in 1814. It was handed over to Germany in exchange for Zanzibar, which thenceforward became a British Protectorate. Before the Armistice, the rock was heavily fortified and bristling on all sides with guns of large calibre. It boasted of a magnificent harbour capable of affording refuge and fuelling to the largest battleships, and during the Great War the island played a most effective role in guarding the mouths of the Elbe and the Weser—the keys to Germany—against the British navy.

The natives of Heligoland speak Frisean and a form of German known as Platt-Deutsch, both thoroughly unintelligible to most foreigners and Germans alike. Many of the older inhabitants, however, have not forgotten their English yet and never miss an opportunity of showing off their linguistic attainments.

The total length of the island is about a mile, and at its widest it is about 500 yards. Its situation relative to the routes of birds migrating southwards in Autumn from Norway, Denmark and the regions of the bleak North to escape the rigours of winter, and back to their homes in Spring, make Heligoland particularly suitable for the study of bird migration. In spite of the vast amount of data that has been accumulated in recent years, and is still accumulating, it has to be admitted that a great many of the essential psychological aspects involved in the phenomenon, continue to remain a mystery. Besides its natural situation, one of the many special advantages the island possesses for a study of this phase of bird life, is the scarcity on the rock of natural tree and shrub growth. Moreover, the fact that the resident bird-life is scanty, both as regards species and individuals, obviates the possibility of confusion and error in regard to the status of birds which arrive on the island from time to time and stop over for a day or two before resuming their journey.

The alarming amount of erosion from the sea, that has taken place in recent years, and still continues to be a menace to the existence of the island, has necessitated the building of a heavy protecting wall of stone, brought in from abroad, along practically the entire length of the western side.

This wall incidentally has become a great convenience to local sportsmen, who take their stanch along it, at short distances from one another, throughout the livelong day. Ever on the alert, these local Tartarins let off a regular fusillade whenever some poor unfortunate bird happens to show itself over the western cliff. The species does not matter in the least; fresh meat is a rare luxury on Heligoland, and thrushes, blackbirds or sparrow-hawks contribute equally towards the deficiency. Many a ringed bird finds its death at the hands of these merciless gunners, and not infrequently within a few minutes after its release from the *Volgelwarte*, as the ornithological station is called.

One particular cliff on the western side between the northern end of the sea-wall and that curious detached needle of rock known as 'Lange Anna,' is the nesting site of a colony of *Lummen* (Guillemots) which are now recognized as a distinct race of *Uria aalge*, namely *helgolandica* Lönnberg. It is remarkable that out of the great stretch of seemingly identical cliffs and ledges forming the precipitous sides of the island, the birds should select just this one portion which is persistently occupied for nesting purposes, year after year. It forms an isolated colony, the only one within a radius of 500 miles, and incidentally also the only one of its kind in the whole of Germany. The birds occupy the cliffs only a few months during the year, chiefly from mid-April to the second half of July. Through the ringing method it has been ascertained that during the rest of the year they wander about mostly on the Norwegian and Scandinavian coasts, and have also been met with in the south-east portion of the North Sea. Some numbers suddenly appear at Heligoland in the winter months from time to time, and vanish again in a few days. The members of the colony do not hold together after breeding is over and roam about in smaller or larger flocks, sometimes even in pairs, the individuals often straying much apart.

Photo. F. Schensky.

HELIGOLAND FROM THE SEA.

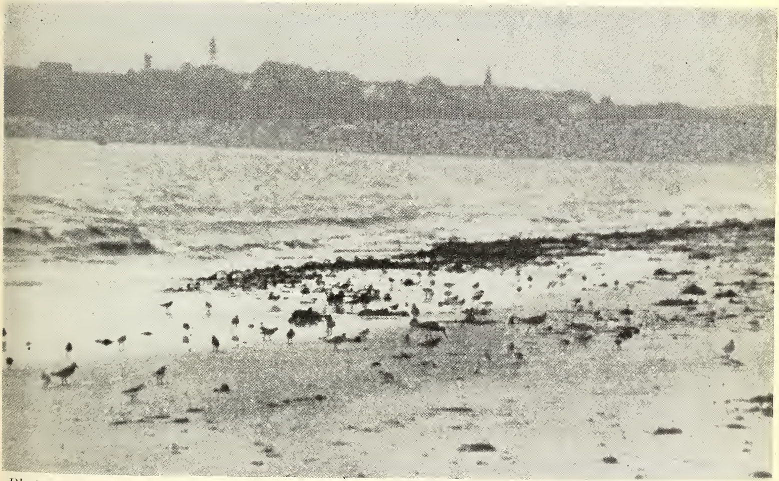

Photo. by Author.

ON THE BEACH, DÜNEN ISLAND (Heligoland in the background).

In the foreground are waders of various species, Black-tailed Godwit (*Limosa limosa*), Sanderling (*Crocethia alba*), Dunlin (*Erolia alpina*), Ringed Plover (*Charadrius hiaticulus*), etc. (The black mass between the birds and the sea is a brown Alga, producing Iodine, vast quantities of which are cast ashore.)

Photo. *by Author.*

"Lange Anna"—a feature of Heligoland.

Photo. *by Author.*

A general view of the Sapskuhle or Trapping Garden, showing dense vegetation.

In addition to the abrupt height of the rock, which stands out at once as a landmark and a haven of rest to the weary wayfarers of the air, Heligoland possesses a powerful lighthouse whose beams (forty-two million candle power) seem to exercise an irresistible attraction on the journeying multitudes on moonless overcast nights.

By virtue of all these favourable conditions, Heligoland has long been recognized as an ideal place for the study of bird movements. Heinrich Gätke, primarily a landscape painter, lived on the island in the last century for a number of years and carried out the pioneer observations and investigations that have made him so famous. It was his monumental work *Heligoland as an Ornithological Station* which, in spite of its somewhat fanciful theories and conclusions, paved the way to a realization of the importance of this type of research. When Heligoland became a German possession the Prussian Government established a Biological Station on the island. Though principally an institution for the purpose of marine research, one or the other of its Zoological staff, in addition to his own duties, continued the investigations started by Gätke after the latter's death in 1897. Dr. Hugo Weigold needs special mention; he took up the thread of Gätke's experiments, and the work under him was carried on with greater exactitude and scientific precision. Dr. Weigold experimented with various devices in the *Sapskuhle* which was a sort of Botanical Experimental Garden (at the northern end of the Oberland) for catching birds for marking purposes, and the existing elaborate trapping arrangements are in a great measure due to his ingenuity and initiative.

In connection with the Biological Station at Heligoland, was started the wonderful little aquarium which now contains such a comprehensive collection of the marine fauna of the North Sea. The station is also responsible for the North Sea Museum, which, besides Marine Zoology, contains the valuable ornithological collections made by Gätke during his residence on the island, and also those brought together later by Dr. Weigold and by the present Director of the Vogelwarte.

In September 1929, I was fortunate enough to spend a fortnight on Heligoland, and was there as much impressed by the methods and thoroughness with which investigations are carried on, as by the facilities always afforded so willingly to students of ornithology. I myself am greatly indebted to the hospitality and kindness extended to me by the keeper of the station, Dr. Rūdolf Drost, which made my visit so interesting and instructive.

Observations at the *Vogelwarte* are carried on throughout the year by day, and also occasionally by night when conditions are suitable. Careful data are recorded from day to day as regards temperature, prevailing winds, and other climatic and physical changes or disturbances, which are all subsequently co-ordinated by means of graphs and charts, and their reaction on bird movements set out in an efficient and comprehensible manner. A number of live birds are kept in an aviary for various psychological and physiological experiments and also for use as decoys. There is a good ornithological library for the use of workers and students, and a complete reference collection of the birds met with on the island as residents, regular passage migrants or rare stragglers. During the time I was there, the rooms were frequented by a number of enthusiastic students from Germany and other European countries, and this, I understand, is the usual state of affairs in Spring and Autumn when bird migration takes place over the island.

Of recent years the *Vogelwarte* has been chiefly concerned with the marking of birds with aluminium rings. Apart from the banding work that is actually done at the station, the *Vogelwarte* has a number of collaborators on the mainland, including four well-organized affiliated marking stations, and the magnitude of its activities as a whole can be gauged from the fact that in the year 1927 alone, no less than 28,478 birds, comprising some 200 species, were marked with the rings of the station. Over 5,000 of these were put on by the *Vogelwarte* itself, while the balance was used by collaborators in various parts of Germany, mostly on nestlings. The figures for 1928 and 1929 are considerably higher, and it is expected that 1930 would show a further improvement.

A large percentage of the birds ringed on the island is captured at the lighthouse. When the nights in Spring and Autumn suddenly become overcast, as frequently happens by wind-blown clouds, the sky over Heligoland resounds with the cries of countless wanderers, who, apparently bewildered in their direction, fly low and are drawn to the beams of the lighthouse as irresistibly as filings to a magnet. It is a remarkable fact that the beams fail completely to attract the birds so long as there are any gaps at all in the clouds through which stars are visible, a fact which makes one wonder if the correct orientation is determined by the stars as by mariners of old! On a really favourable night, as many as 1,200 or more birds may be secured at the light. This, at Heligoland, furnishes practically the only opportunity of obtaining shore birds such as Golden Plovers, Lapwings, Sandpipers, etc., for ringing purposes. In the ordinary course of events, though some numbers do stop over on the Düne, where they are caught with nets and decoys, the majority pass over to the coasts of the mainland which lie only a few miles further. The difficulty otherwise invariably experienced in catching adult *Charadridae* for marking in sufficiently large numbers, is thus easily compensated for by occurrence of the requisite type of weather, and the *Vogelwarte* looks forward to it eagerly.

A successful night (unfortunately I missed this during my visit) is graphically described by Gätke, and his description gives some idea of the joy it must occasion in the heart of an ornithologist. 'The whole sky' he writes, 'is now filled with a babel of hundreds of thousands of voices, and, as we approach the lighthouse, there presents itself to the eye a scene which more than confirms the experience of the ear. Under the intense glare of the light, swarms of Larks, Starlings and Thrushes career around in ever-varying density ; like showers of brilliant sparks or huge snow-flakes driven onward by a gale, and continuously replaced as they disappear by freshly arrived multitudes. Mingled with these birds are large numbers of Golden Plovers, Lapwings, Curlews and Sandpipers. Now and again too a Woodcock is seen ; or an Owl, with slow-

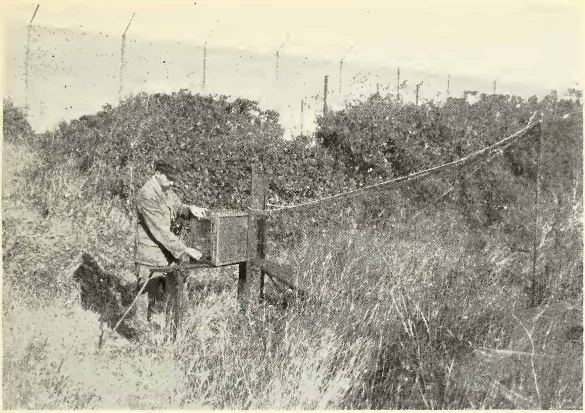

Photo. *by Author.*

Dr. Drost removing trapped birds from Trap No. 1.

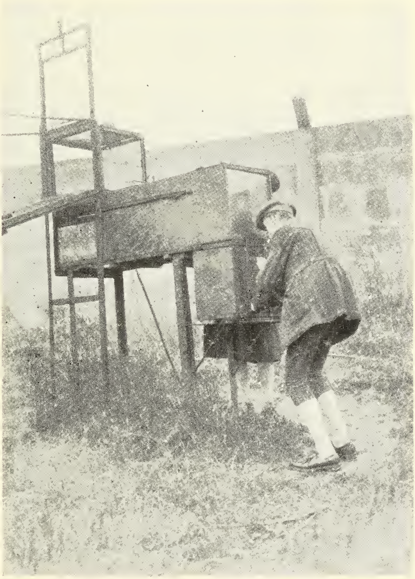

Photo. *by Author.*

Dr. E. Stresemann at Trap No. 3.
(Note more elaborate box.)

Photo. *by Author.*

Ringing in progress at the Sapskuhle. (On the curved wires near the window are threaded rings of various sizes handy for use.)

Photo. *by Author.*

A ringed Sparrow-hawk (*Accipiter nisus nisus*) ready to be released.

beating wings, emerges from the darkness into the circle of light, but again speedily vanishes, accompanied by the plaintive cry of an unhappy Thrush that has become its prey'.

Under the necessary meteorological conditions, the birds arrive at the lighthouse at practically all hours after dark, the stream frequently continuing unbroken throughout the night. They dash against the panes of glass around the lantern and fall dazed on the balcony surrounding the turret, while some may even be killed outright by the impact. A great many flutter to the ground below, and such are their numbers that for yards around the base of the tower the meadows are just pulsating with life. At the *Vogelwarte* night is transformed into day, the whole establishment turns out in force with lanterns and gunny sacks which soon bulge with quivering masses of migratory fowl. The inhabitants of Heligoland also sally forth to replenish their larders, while the cats, which like the pariah dogs of pre-war Constantinople, are a feature of the island, likewise appear on the scene in their numbers, taking heavy toll of the weaklings and wearied-out travellers resting in the fields. For superstitious reasons, the inhabitants of Heligoland assiduously protect the feline population, and though the hand of the *Vogelwarte* is incessantly up against this veritable plague, diplomacy forbids their causing the creatures any harm in broad daylight. Migration nights, while Heligoland is mostly asleep, therefore, are the only occasions when ornithologists and cats may meet each other on an equal footing, and on such do the former seize the long-awaited opportunity of avenging the murder of so many innocents. Though I hesitate to make a general statement such as may involve me in libel proceedings, I am acquainted with at least one youthful bird enthusiast at whose hands many a sneaking bird-snatcher has met his sudden and violent end. His procedure was simple enough; he grabbed the cats by the scruff of their necks and just let them down over the precipice into the dashing waves in a most matter-of-fact sort of way. The sun rose next morning on so many cats the fewer; none-the-wiser Heligolanders continued in blissful ignorance!

The sacks are conveyed to the Vogelwarte office; each bird is properly identified and marked with a ring of appropriate size. When the number of birds is not too great to permit such detailed attention, each individual is also carefully weighed and its age, as far as possible, determined. The relative particulars are then carefully noted on the necessary forms and registers and the birds are released.

So much for work at the lighthouse which, clearly, can provide birds only once in a way. In addition, the *Vogelwarte* has a special trapping garden—the *Sapskuhle*, reference to which has already been made—where smaller birds, mostly passerine (but also often Sparrow-hawks, Woodpeckers, and even Woodcock) are caught in cleverly constructed wire-netting traps which insure the minimum of accidents to the birds. Owing to the heavy gales which continually sweep over the island, there is practically no natural tree-growth on the *Oberland*. Trees and shrubs being a desideratum for attracting birds, the *Vogelwarte* decided to utilize the old experimental Botanical garden for the purpose. The site of this garden is a piece of low-lying ground in a natural basin-like depression at the northern end of the *Oberland*. This was further deepened and enlarged, and at the present time has a rectangular shape about 150 yards long by 30 wide (the figures are approximate and from memory). For further protection of the vegetation, the basin has been enclosed by a wall about 8 feet in height, and the whole area planted over with trees and shrubs in more or less parallel rows throughout its length. Thus sheltered, the vegetation within the *Sapskuhle* has thriven remarkably, and it now presents a patch of dense green cover comprised of bushes, thickets and trees of moderate size. This being practically the only greenery on the rock, no weary bird passing over the island can resist alighting there for food and rest.

After a great deal of experimenting with movable twine nets, the present three permanent traps of wire-netting have been evolved, and very successful is the working of these. The netting is painted green to harmonize with the surrounding foliage. In width, the traps extend from one side of the Sapskuhle to the other, and taper lengthwise towards the northern end where each terminates in a narrow, wooden box fixed at an angle. (See diagram.) The *modus operandi* is for three or four persons to enter the shrubbery at the south end and walk abreast, at short intervals from one another, towards the opposite end of the garden, beating the bushes with sticks and driving the birds forward. The birds hop from bush to bush or skulk along the undergrowth in front of the line of beaters till unconsciously driven into the tapering neck of trap No. 1. At the distal end of this neck there is the box at an angle with a transparent pane of glass just opposite where the bird would try to get out. The bird naturally makes straight for this seeming exit, and as it dashes against the obstructing pane, the drop-door A is lowered by one of the beaters by means of a cable worked by a weighted handle (B) further up the neck. Having concentrated all the birds of trap No. 1 into this box, the drivers open the exit (C) and work towards trap No. 2 which in principle operates in the same way, passing thence to No. 3. When all three traps have been worked, the birds are removed from the end boxes and carried in little bags or cages to a room situated in the south-west corner of the *Sapskuhle* where they are ringed, and the necessary particulars being recorded, released. Some of these marked birds may be caught two or three times in quick succession on the same day.

In addition to marking with aluminium rings, some individuals of the more uncommon migrants are also painted in parts with various fast-coloured dyes. This method enables one to judge how long a particular individual stops over at a particular spot, and also to learn something about its local wanderings without having to catch it again to examine its ring.

The great charm about Heligoland as a trapping centre lies in the vast variety of species that are taken at the *Sapskuhle*, which one can handle and examine at close quarters. Some of the species secured during the time I was there were: *Prunella modularis*, *Phoenicurus ochrurus*, *Fringilla cœlebs*, *Phylloscopus sybilatrix*,

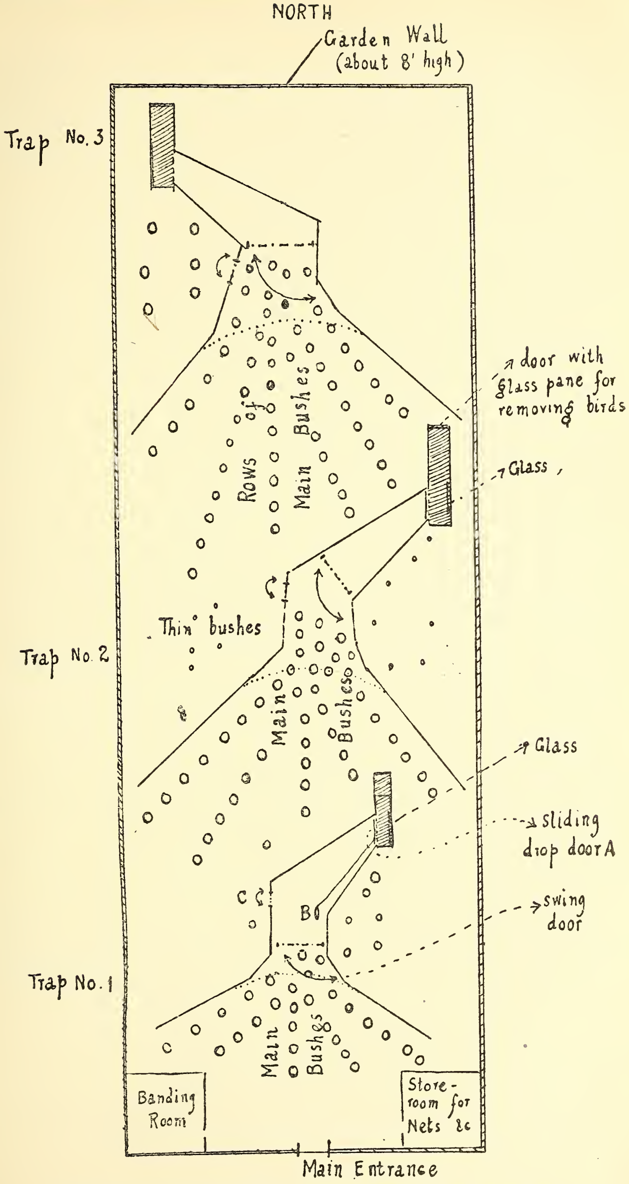
NORTH
Garden Wall (about 8' high)
Trap No. 3
door with glass pane for removing birds
Rows of Main Bushes
Glass
Thin bushes
Trap No. 2
Main Bushes
Glass
sliding drop door A
C
B
swing door
Trap No. 1
Main Bushes
Banding Room
Store-room for Nets &c
Main Entrance

Diagram to illustrate system of traps used in the Sapskuhle.

Troglodytes troglodytes, *Regulus regulus*, *Anthus pratensis*, *Sylvia curruca*, *Dryobates major major* and *Accipiter nisus*, while we also took in one day two specimens of what I understand is a very rare passenger, *Siphia parva*. Our most successful day at the *Sapskuhle* was with about 150 birds, but I can well imagine that on occasions it is possible to do considerably better.

Just during the month I was on the island, there was an abnormally strong migration of *Dryobates major major* in progress. For want of suitable trees the birds (principally young of the year) were driven to behaving in the most silly and unconventional manner, clinging to fence-posts, hopping along the ground, perching on house-tops and chimneys, and so forth. They had the greatest difficulty in obtaining food, and many of them were picked up dead, hunger doubtless being one of the main causes. This was shown in the case of one young bird which was captured on September 27th, dyed, ringed and released. Its weight then was 96·8 grammes. This same individual, after having been observed several times in the interval, trying to obtain food in various impossible situations, was again caught in the Sapskuhle on 30th September. It then weighed only 77·25 grammes, showing that in three days it had lost nearly one-fifth of its original weight.*

Another point so striking about the migrants over Heligoland—and this is the factor that contributes towards the uniqueness of the rock for observation purposes—is, that practically every day during the migration seasons there is a change in the predominating species. They come, as it were, in waves of varying density, and one can say about the place that literally not a single bird escapes observation. For example, one day one finds a swarm almost entirely consisting of *Fringilla cœlebs ;* next day these birds are all gone except perhaps a few stray individuals, and *Accentor modularis* has taken its place. On the third day it may be *Anthus trivialis* that has invaded the meadows, or *Phoenicurus ochrurus* or something else, while at other times it may be a day for sparrow-hawks! Numerically, the Hooded Crow (*Corvus cornix*), the Starling (*Sturnus vulgaris*), and the Skylark (*Alauda arvensis*) are perhaps the most important migrants over Heligoland. Of the first, Dr. Drost has estimated about 20,000 flying over or past the Island in one day alone (in October 1926). The total number of species and races so far taken amount to 415.

At the present time nine different sizes of rings are being employed by the *Vogelwarte*, numbered from 1 to 9. Numbers run serially commencing with 1 for each size of ring, but each series carries the figure denoting size as the first cipher ; for instance ring, No. 43 of sizes would be seen on the ring as 843, and so on. The different sizes are used as follows :

No. 1 for eagles.
,, 2 ,, storks.
,, 3 ,, ducks, buzzards, goshawks, etc.
,, 4 ,, crows, pigeons, etc.
,, 5 ,, sparrow-hawks, etc.

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* (H. Desselberger, *Ornith. Mon.*, xxxvii, 6, 1929).

No. 6 for thrushes, starlings, etc.
,, 7 ,, larks, finches, etc.
,, 8 ,, small passerine birds.
,, 9 ,, very small birds such as *Regulus*, etc.

Results.—The total number of birds ringed by the *Vogelwarte* and its several collaborators from the time ringing was first started on the rock by Dr. Weigold, in 1905, up to the end of 1928 was 102,095, comprising some 228 species. Of this number 68,176 birds were ringed between 1926 and 1928. The recoveries reported during this period amount to 2,119, or a little over 3 per cent. It has been found that, while the average of recoveries as a whole comes to about 2–3 per cent. in the case of the smaller passerine birds, the percentage is often as low as 1. The best results are obtained with the Hawks and the *Charadridae* which is but natural considering that wading birds are hunted all over Europe, especially in the southern countries, while birds of prey are so generally and indiscriminately slaughtered as vermin.

A very interesting fact which has resulted from the recovery of ringed Heligoland birds is that, contrary to the formerly accepted belief that the migratory movements of birds lay in the direction of north to south and *vice versa*, most Central European birds, at any rate, travel in a pronounced south-westerly/north-easterly direction, whilst others (the Cuckoo for example) travel south-east and north-west.

The Need in India.—If one wades through all that has been hitherto written concerning the birds of India, one cannot fail to be impressed by the paucity of reliable data in regard to the problem of bird migration in this country. It must be obvious to everybody that migration does take place, and that on a gigantic scale; winter visitors commence to arrive in numbers as early as the end of September, and to depart again by the middle or end of March. But beyond these merest rudiments, the present state of our knowledge will not carry us. It may not be difficult to guess with some measure of probability as to where, for instance, some of our wild ducks go when they forsake us at the commencement of the hot weather, considering that large numbers of these birds are known to breed in Siberia which have been absent from those regions in winter. Similarly we may be able to put two and two together in the case of other species with a tolerable degree of accuracy, but precision of any sort is lacking, and we cannot step beyond the bounds of conjecture. In spite of the fact, therefore, that the annual movements to and from India involve individuals whose numbers are beyond computation, all squeezed within the limits of about three months each way, who can tell what routes the birds follow on their travels? Do they cross directly over the Himalayan barrier at heights hitherto unsuspected by us, or do they habitually seek some favourite gap in the chain of mountains that separate the plains of India from the Central Asian Steppes? From the meagre records of observers, it is evident that, a certain amount of passage occurs through the Indus gorge at Attock, as also at great heights over the mountains; to what extent in relation to the entire movement this may be, we have of course no means of estimating.

Individual observation at suitable stations, especially if extending over a number of years for the same area, is undoubtedly of very great value, but in a vast country like India, where unfortunately the majority of the people who take an interest in sport and natural history are also chiefly those who are not stationed in any one place for sufficiently long periods, it is obvious that little can be expected from the purely observational method. Besides, even of those who are favourably placed as regards locality, and *willing* to take advantage of their opportunities, how many are qualified to supply data of any real value ? This pre-supposes a sound working knowledge of field ornithology, involving often the ability to distinguish species on the wing by their cries where the height is too great to render identification by sight possible.

Having regard to all these difficulties and handicaps, one can easily understand that the only method of investigation likely to yield results of real importance in India is the ringing method. For the present, as is the case with the Society's Ringing Scheme, our activities should be restricted to ducks and other sporting birds, which, in the absence of trapping centres throughout the country—an organization like that of the Department of Biological Survey in the U. S. A.—are likely to yield more recoveries than the smaller passerine species. Besides rings, a certain number of birds might also be painted in parts with fast-coloured dyes to make them more conspicuous on the wing. The advantages of this method have already been pointed out. The colours would of course be lost at the next moult, but many important facts may be brought to light in the interval without rendering the bird permanently liable to destruction by human agency.

The results obtained during the short period the Society's Ringing Scheme has been in operation in India—published from time to time in the *Journal*—are sufficiently interesting and encouraging to justify the work being taken up on a much larger scale. Results are bound to follow in proportion. It is particularly fortunate for us in this country that so much attention is being paid at the present time to bird-ringing in Russia, where principally nestlings are banded at the breeding season. With co-operation of the kind we have so far received from the Russian authorities in regard to our scheme, the best possible success may be anticipated.

What we in India want badly is a central organization for ornithological research—an institution which would have observation centres in charge of competent ornithologists in suitable places all over the country. Perhaps it might seem hardly rational to expect such ' extravagance ' upon such an apparently unremunerative and revenue-eating department with the deficit budgets which have of late unhappily become the rule in our country. Strange as it may sound, however, the fact remains that post-war Germany, with all her poverty and all her liabilities, does maintain such an institution, and a most efficient one at that !

Let us hope that the importance of ornithological research will be recognized before it is too late ; in an agricultural country like India, the value of such work cannot be over-estimated.

A NEW INDIAN DRAGONFLY. (ORDER—*ODONÀTA*)

BY

LT.-COL. F. C. FRASER, I.M.S., F.E.S.

(*With 2 Text-figures*)

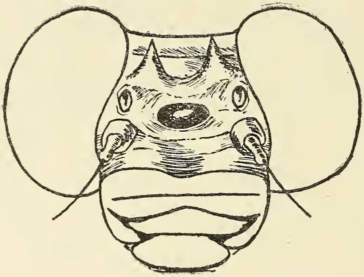

FIG. 1. Head of female *Leptogomphus bidentatus* sp. nov.

LEPTOGOMPHUS BIDENTATUS sp. nov.

Male. Abdomen 38 mm. Hindwing 33 mm.

Head black marked with yellow; labium with lateral lobes yellow; labrum black with a small yellow spot on each side; anteclypeus with a small median yellow spot; postclypeus and frons broadly yellow; vertex black but with a small rounded spot behind the ocelli and the whole of occiput yellow.

Prothorax black with a large yellow spot on the median and posterior lobes and a small spot on each side of the former.

Thorax black marked with yellow as follows, a mesothoracic collar interrupted in the middle, an oblique antehumeral stripe, the upper ends of which are squared and closely opposed to the antealar sinus, the lower ends pointed and divergent not meeting the mesothoracic collar; laterally marked with two broad yellow stripes, the posterior of which covers about four-fifths of the metepimeron; between these two stripes a small upper spot.

Legs black, spines of hind femora gradually lengthening towards the distal end, very robust and rather short; hind femora extending to distal end of segment 1.

Abdomen black marked with yellow as follows, segment 1 with a quadrate middorsal and a large lateral spot, its apical border narrowly yellow; segment 2 with a trilobate middorsal stripe and two large spots on each side, one of which includes the oreillet and extends to base of segment; segments 3 to 9 with paired subdorsal basal spots, which on segments 7 and 8 extend distad of the jugal suture: segment 10 with a small lateral spot.

Anal appendages black; superiors moderately broad at extreme base, then constricted and again dilating and tapering to apex somewhat like a carrot, the apex turning out and acute; seen in profile the basal two-thirds broad, the apical truncate and retrousse, furnished below with two ventral teeth, a basal small, and a submedian robust, the basal tooth lying in a plane internal to the median; inferior appendage barely one-third the length of superiors, broad, its apex with a small upturned spine on each side of a rather deep notch.

Wings hyaline tinted with yellow at the base ; pterostigma black or dark yellow framed in black, braced, covering 3 to 4 cells ; nodal index $\frac{14\text{–}15}{12\text{–}10}\Big|\frac{14\text{–}13}{10\text{–}13}$; triangles traversed once in the hindwings (twice in the hindwing of one female ; 5 rows of cells in the anal field ; anal loop absent).

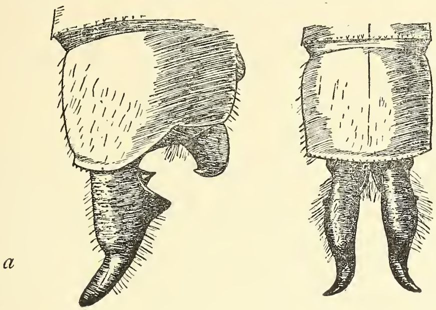

FIG. 2. *Leptogomphus bidentatus* sp. nov.
a. Lateral view of anal appendages. *b.* Dorsal view of same.

Female. Abdomen 38 mm. Hindwing 35 mm.

Markings very similar to those of male, abdominal markings differing as follows,-segment 2 with the lateral spots confluent with one another to form a broad stripe ; segments 3 to 6 with additional lateral spots in line with the basal, elongate on segments 3 and 4, very small and short on segments 5 and 6 ; segment 10 unmarked.

Anal appendages short, black, simple ; vulvar scale one-fourth the length of segment 9, triangular, narrowly bifid so as to form two closely apposed scales.

Head of female with the vertex raised and sloping back as a thick quadrate plate, the hind corners of which are prolonged as robust spines.

Habitat. Shillong, Assam. Two females and one male taken by Mr. T. Bainbrigge Fletcher, 19, vii. 28. One female was found emerging on the side of a small cement tank. Type to be deposited in the British Museum.

This species is interesting from its extraordinary type of breeding place and also from the triangles of the hindwings being traversed, a characteristic shared by *L. retroflexus* Ris. and *L. scorpio* Ris. from both of which it however differs by the entirely different shape of the anal appendages and other characters. The shape of the superior anal appendages will also serve to differentiate it from other species, *L. semperi* Selys, *L. assimilis* Krug., *L. gracilis* Krug., *L. gestroi* Selys, *L. lansbergei* Selys. From *L. inclitus* Selys, female only known, it is to be distinguished by the frons yellow and by the absence of a humeral stripe. The genitalia appear to ally it closely to *L. sauteri* Ris., *L. perforatus* Ris. and *L. scorpio* Ris., the tapering ends of the superior appendages distinguishing it from the two former species.

THE ORIGIN OF CONTINENTS AND OCEANS

ACCORDING TO THE

DISPLACEMENT THEORY

BY

W. E. WAIT, M.A., F.Z.S.

(*With 1 plate and 5 text-figures*[1])

For some time past there have been differences of opinion between palæontologists and physical geologists regarding the extent and relative position of the continental land masses during former geological periods. The palæontologists, from their study of the fossil *fauna* and *flora* and from the affinities of the present *fauna* and *flora* in the various regions of the earth, insist that the evidence undoubtedly demands the former existence of wide land connections between continents which are now separated by the great oceans. For instance, they are largely agreed that in the Jurassic period there was such a land connection between Africa, India, Malaya and Australia on the one hand, and between Africa, South America, Antarctica and Australia on the other. They assume the existence of a wide continent which then filled the present Indian and South Atlantic oceans, and this 'lost continent' is known to geologists as Gondwana-land. The link between Australia and Indo-Africa parted in the Jurassic period; the connection between Africa and South America broke down in the Cretaceous; that between India and Africa, some time between the closing period of the Cretaceous and the early days of the Eocene. The connection between South America and Australia *via* Antarctica persisted until the Eocene, when the Australian continent became separated; the land-bridge between Antarctica and South America probably persisted somewhat longer. Similarly, there was a more or less continuous land-bridge, they say, between Europe and North America, which only broke down finally in the Glacial period.

Those geologists, however, who are more intimately concerned with the structure of the earth's crust maintain that from their point of view there are almost insuperable difficulties in the assumption of former wide land connections across the present ocean floors. In the early days of scientific geology, it was assumed that the continents, mountain chains and ocean depressions came into existence owing to the contraction of the earth through cooling. The skin of the earth became wrinkled, much as the skin of a drying apple becomes wrinkled as the fruit loses substance through evaporation. According to the conception of Sir Charles Lyell, a noted English geologist in the middle of the 19th century, this gradual shrinkage, through cooling, led to an unending alternation in the folds of the earth's surface. The deep sea-floors emerged in places on the surface of the earth, and the continents in places sank to the deep sea-floors.

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[1] The plate and text-figures are reproduced from Wegener's *Origin of Continents and Oceans* by courtesy of Messrs. Methuen & Co., Ltd.

Fuller and more detailed knowledge, however, of the sedimentary rocks and of the structure of mountain chains has led to the abandonment of this theory. Modern geologists agree that though the vast majority of the sedimentary rocks which now cover so large a portion of the earth's surface were laid down on the floor of the sea, they were all deposited in comparatively shallow water, such as one might find in the North Sea or Mediterranean. The abyssal red oozes which have been dredged from the floor of the ocean at the deepest levels have a very distinct character, markedly different from the sandy or calcareous deposits laid down in shallower seas. With the exception of certain small patches, about which there is divergence of opinion, nowhere do we find among these vast sedimentary strata any which bear evidence of deposition at abyssal depths such as stretch uniformly over the main areas of the present oceans. There is no clear evidence, therefore, that former wide oceans have ever been elevated into land surfaces.

Further, though it is beyond dispute that great mountain chains such as the Alps, or Himalayas, have been formed by the elevation of sedimentary rocks which once lay at the bottom of moderately shallow seas, the forces which heaved them up cannot be explained by a mere wrinkling of the earth's crust on contraction. The present breadth of the Alpine mountain system is about 100 miles. If, however, one could flatten out all the contorted sedimentary strata of which this system is largely composed, these strata, when laid down horizontally, would cover a far larger expanse.

Modern experts who have carefully studied the structure of the Alps calculate that this horizontal expanse would probably measure at least 400 miles, possibly twice as much. The strata have been compressed and heaved up by forces which exerted enormous lateral thrusts : no mere wrinkling, or contraction on cooling would account for their present position. In the face of such evidence, geologists have had to abandon Lyell's conception and to admit that the oceans have never changed places with the continental masses.

Supporters of the land-bridge theory have therefore fallen back on the assumption that 'lost continents' such as Gondwana-land have foundered *en masse*, as the result of huge faults and fissures in the upper crust of the earth, and now lie on the floor of the ocean. The present continental blocks still remain uplifted under the action of arching pressure. The geo-physicists, however, point out that this theory is open to two serious objections. If areas of the size of a continent are to sink more or less uniformly to a depth of over 15,000 feet, and to become deep ocean basins, as each new basin filled itself the surface of the ocean would thereby be lowered a thousand feet or more over the rest of the world. You would have to assume, therefore, that the ocean level was many hundred feet higher before each catastrophe took place than afterwards. The re-elevation of the various lost continents would raise the surface of the waters so much that practically all the continents former or present, with the exception of the mountains, would be completely flooded. In other words, the continuous land-bridges, which are postulated, could not have existed.

Secondly, the theory of effective arching pressures holding up the crust of the existing continents does not harmonize with the results obtained by the gravity measurements which have been taken all over the surface of the globe. The results given by these gravity measurements can only be explained in a satisfactory manner by the theory of isostacy, or the equilibrium of the earth's crust. According to this theory, the relatively light upper crust of the earth floats in equilibrium in a somewhat heavier layer of magma, or more or less fluid lava. Where this upper crust is more heavily weighted, as where a mountain chain occurs, it will sink more deeply into the magma, just as a block of floating wood, when weighted, sinks more deeply into the water.

A heavy cap of ice in the polar regions has the same effect as a mountain chain in depressing the crust. The presence of raised beaches in Central Scandinavia shows that during the Great Ice Age that country, which, we know, was covered by an enormously thick ice-cap, was depressed at least 750 feet. As the Ice Age passed away and the cap melted, the land slowly rose to restore the equilibrium. Records of levels taken over a number of years show that Scandinavia is still slowly rising at the rate of one metre in a hundred years. As the Ice Age passed away at least 10,000 years ago, these measurements give some idea of the extreme slowness of the earth movements which have to be taken into account by geologists.

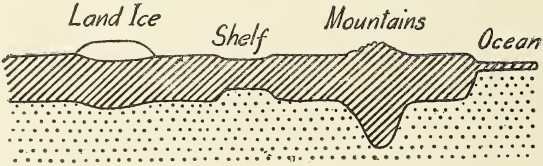

Diagram A. showing section across the Litho-sphere or upper crust of the earth.

Diagram A gives a section across the litho-sphere, or upper crust of the earth, according to this theory, which is now generally regarded as satisfactorily proved. Under the ocean the crust would be relatively thin; under the mountains it increases in thickness; under a 'shelf', or shallow inland sea, it again becomes thin, while under the weight of an ice-cap it becomes depressed.

It will be seen that the acceptance of this theory precludes the assumption that whole continents floating in equilibrium can be torpedoed and sunk without leaving a trace.

Within the last few years, however, an Austrian Professor named Alfred Wegener has propounded an extremely interesting theory which, if accepted, meets the requirements of both the opposing schools. It is generally called 'The Displacement Theory'. Stated very briefly, it assumes that the continents as we know them were, in former geological periods, grouped together in one great land mass, and have since drifted apart from each other to take up the positions which they occupy at the present day.

In this paper it is not possible for me to do more than touch upon a few of the main points of the theory and of the evidence in its support. Those who wish to obtain further information must consult Professor Wegener's own book *The Origin of Continents and Oceans,*[1] an English edition of which was published in 1924.

Wegener tells us that the idea first came to him in 1910, when he was struck by the similarity in shape of the coast-lines of West Africa and Brazil. If you cut out the outline of the Brazilian coast-line from a map, and place it against that of West Africa, you will find that the two fit into each other almost with the accuracy of a jig-saw puzzle. At the time he disregarded the notion, as it seemed too improbable, but a year or so later he became acquainted with the palæontological evidence for a former land connection between the two continents. Delving further into the subject, he came upon such important confirmations of his first surmise that he was convinced of the fundamental correctness of his idea. For instance, he found that in the extreme south of Africa there is a mountain fold of the Permian age, running from east to west—the Swarte Berg of Cape Colony. If you fit the coast-lines of the two continents together this range would lie opposite the American coast south of Buenos Aires. Now, in the Sierras of this area we find a series of strata, which, in their structure, the succession of the rocks and their fossil contents are absolutely similar to the mountains in Cape Colony. Further North the enormous gneiss plateau of Africa shows great similarity to that of Brazil. Not only the igneous rocks, but the sedimentary beds associated with them, and the direction of the strata folds are in close agreement. The diamond-bearing regions of Brazil are of the same formation and contain the same peculiar features as those of the Kimberley diamond mines.

Between Europe and North America we have similar correspondences in the geological structure. The folded carboniferous strata which extend across Central Europe from east to west reappear on the American side and make the coal deposits of North America seem the direct continuation of those in Europe. Immediately to the north of these strata lies a belt of older rocks, dating from the Silurian and Devonian. This belt traverses Norway and Scotland and reappears in East Canada. North of this again the gneissic mountain system of North-West Scotland and the Hebrides lies opposite a similar system running from Labrador far into the heart of Canada.

The assumption—underlying the theory—which accounts for the possibility of such vast horizontal movements in the continental masses, is in reality just one step forward in the theory of isostasy, which I explained a little earlier. According to the displacement theory the upper crust of the earth is composed solely of the continental masses. The underlying layer lies exposed on the ocean floor, where the upper crust is altogether absent, and not merely thinner.

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[1] The Origin of Continents and Oceans by Alfred Wegener. Translated from the third German Edition by J. G. A. Skerl. 44 Illustrations. Methuen Co., Ltd., 36, Essex Street, W.C., London.

In this introduction to Professor Wegener's book, J. W. Evans, a former President of the Geological Society, points out that the oldest rocks on the earth's surface, which everywhere underlie any sedimentary rocks and which form by far the greater part of the continental masses, mainly consist of the more acid varieties, granite and gneiss. These are comparatively lighter than the basic rocks and are composed predominantly of silica, alumina and the alkalis.

Professor Wegener refers collectively to these acid rocks as 'sial'—a portmanteau term made up of the first syllables of silica and alumina, their two main constituent minerals. Dr. Evans continues: 'There is good reason for believing that the rocks forming the sub-stratum of the ocean bed are more basic in composition and contain a large proportion of magnesia, iron-oxide and lime, and that similar rocks, or magmas of the same composition, underlie the sial of the continents and probably form a zone of the earth's substance some 1,500 kilometres in depth'. These basic rocks do occur in places on the earth's surface, but are generally believed to have been erupted from great depths in the form of lava flows. Professor Wegener terms these rocks 'sima'—from silica plus magnesia—as distinguished from 'sial'. The sima is heavier than the sial, and, though somewhat harder, melts at a lower temperature. Professor Wegener, then, assumes that the sial and the sima form two separate layers and that the continental sial masses float in the heavier sima somewhat in the same manner as icebergs float in the sea. To support his supposition that they are two separate layers, he brings forward as evidence the statistics regarding the contours of the earth's crust. If the continents and the ocean floors were but one continuous layer, you would expect to find that the highest mountains and the greatest ocean depths would constitute the greatest deviations from a single mean. In other words, if you divided the whole surface of the globe into square miles and then plotted the series of measurements, given by each square mile, of its altitude above, or its depth beneath sea level, you would expect to find that the greatest number of measurements would gather round a single mean about half way between the two extremes, somewhat as shown in the dotted line in Diagram B. This, however, is not the actual case. We find two levels round which the measurements cluster: one for land surfaces

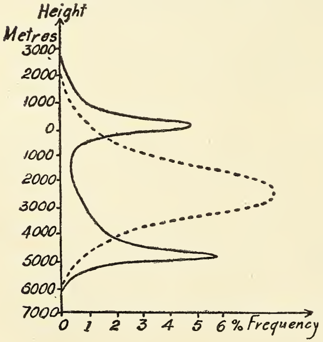


Diagram B.

at an elevation of about 100 metres, and the other for ocean soundings at a depth of about 4,700 metres—*vide* the continuous lines on the diagram. The series of measurements may be shown in another way as in Diagram C.

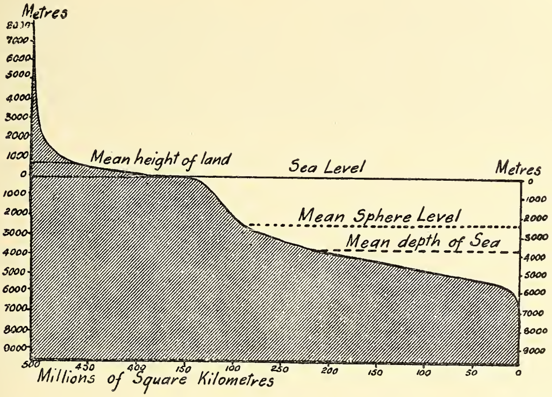


Diagram C. Hypsometric curve of the earth's surface, after Krümmel.

If you take a section across a continent, the bulk of it lies at no great height above the sea level, and mountain heights occupy a very small portion of its surface. If, however, you take a section across the ocean, you will find that, as soon as you leave the shelf of shallow water adjoining any continent, the sea-floor dips rapidly to ocean depths, which stretch almost horizontally for enormous distances. Compared with land surfaces, the ocean floor is surprisingly level and the mean depth, as mentioned above, is 4,700 metres, or nearly 15,500 feet below the level of the land. It is not very difficult to assume that we have here two original levels : that is, two separate layers.

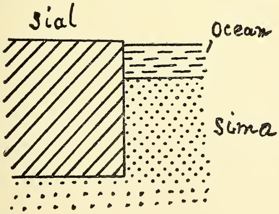


Diagram D. Section through margin of continent.

Diagram D gives in diagrammatic form a hypothetical section through the margin of a continent. On the left you have the sial block floating in the sima, on the right is the floor of the ocean where the sima lies exposed.

We now come to the crux of the whole theory. How can the sial crust be rifted asunder and how can the continental blocks drift apart through the solid basalt medium which composes the ocean floor?

Professor Wegener freely admits that the sima is more rigid than steel. He points out, however, that a substance may be hard and yet viscous, and he quotes J. G. Maxwell's definition of viscosity. 'When the very smallest stress, if continued long enough, will cause a constantly increasing change of form, the body must be regarded as a viscous fluid, however hard it may be. Thus a tallow candle is much softer than a stick of sealing-wax, but if the candle and the stick of sealing-wax are laid horizontally between two supports, the sealing-wax will in a few weeks, in summer, bend with its own weight while the candle remains straight. The candle is therefore a soft solid and the sealing-wax a very viscous fluid'.

Fastening on this illustration given by Maxwell, Wegener compares the sial crust with the tallow candle and the sima with the stick of sealing-wax. Sealing-wax dropped on to a hard floor will splinter into fragments, but, given time, under the force of attraction it will flow of itself. He goes on to point out that even steel loses its rigidity under such pressures as we can mechanically produce, and becomes plastic. A steel sphere, of the same size as the earth, would, like sealing-wax, flow under the influence of its own attraction, provided the necessary time were given for it to develop a change of form. In fact, for such dimensions as the earth, he maintains that no solid body exists and that all bodies have the property of viscid fluidity; but the time needed for their change will differ according to their degree of viscosity.

The movement of the sial may be illustrated by yet another laboratory experiment. You cannot force a piece of cork through a sheet of pitch, but if you place the cork at the bottom of a vessel and cover it with the pitch, it will in the course of time rise to the surface. The ice in glaciers is seemingly solid, yet under the force of gravity the glacier develops a steady flow.

As geological time is measured in thousands and millions of years, we can allow the sima sufficiently long periods in which to develop its viscous properties. At a moderate computation we can give India more than ten million years to drift from the side of Africa to its present position. The average rate of movement would be less than a yard in a year. Again, Wegener points out that in the lower depths of the sima layer the mobility will be increased by high temperatures. The melting point, too, of the sima is lower than that of the sial, so that molten sima and solid sial could exist side by side.

Further he sees 'no reason why such slightly different materials as sima and sial should completely separate, or have separated, in the body of the earth. Much more probably, there has been, from the beginning, a gradual transition from one to the other'. His own picture of the structure of the sial crust and its relative position to the sima is given in Diagram E, which is nothing more than an elaboration of Diagram A, illustrating the theory of isostasy.

'Uppermost, we have a zone of continuous sial with isolated inclusions of sima; below this a dove-tailed zone in which each of the two portions is continuous; and beneath all a zone of continuous sima in which lie a few isolated masses of sial.'

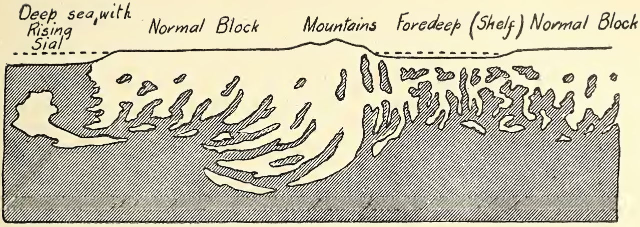


Diagram E. Section through sial crust.

With the development of the rifts which split the sial crust asunder there would be great compression on either side of the rifts. Some sima from the inclusive masses would be forced downwards, some would rise as in volcanoes, or would well up through the rifts and spread out in great horizontal lava flows, such as are found in the Deccan, Brazil and elsewhere. During the great driftings of the continents a kind of gliding plane would be formed on the under surface of the sial, and masses of comparatively plastic sial, at the lower depths, would become detached and slowly rise, like cork through pitch, through the ocean floor in the wake of the drifting continents. This would explain the existence of such isolated oceanic islands as the Seychelles and many of the South-Sea-Island clusters.

In the diagram the comparatively thin crust of sial laden with sima inclusions, shown under a 'fore-deep', or continental shelf, marks the site of an inland sea, such as formerly existed where the Alps and Himalayas now stand. A fore-deep would ride so low in the sima layer that its surface would fall somewhat below sea-level. It would also form a weak zone in the sial crust, which would be predestined for mountain folding when compression came into play. Such a structure of the crust would afford an explanation of the geological fact that large mountain chains are generally formed on the site of former inland seas, while the process of mountain building is accompanied by great lava flows and outbursts of volcanic activity.

In assuming the occurrence of rifts large enough to split off continental masses, Professor Wegener has full geological justification. A huge, almost continuous system of rifts on a comparable scale is well-known to geologists: I allude to the great African Rift-Valleys. This system of rifts begins in the north of Palestine, where as many of you, no doubt, are aware, the valley of the Jordan and the Dead Sea lie in a trough many hundred feet below sea-level. This trough-like fault continues southwards through the Gulf of Akaba to the Red Sea, where the ocean has already invaded the depression. It is probable that here the rift has widened and that the sima-floor already lies uncovered. The fault system then branches south-west and is continued in the great Rift-Valleys of

East Africa, where the long narrow lakes, such as Lake Rudolf, Tanganyika and Nyassa lie in huge canyons with wall-like slopes. These valleys are obviously huge rifts in the Continental plateau, and not mere valleys of erosion. Lake Tanganyika in places reaches a depth of 8,000 feet or more, while the plateaux which border it on either side attain an elevation of 6,000 to 9,000 feet above sea-level. This particular lake is of considerable geological age, but in other parts of the system the rifts cut through sedimentary rocks which are no older than the Pliocene.

It is clear, therefore, that the rifting process may take a considerable period to develop. The great African system may be looked upon as a continental rift which has either stuck half way, or which has not yet had time to attain completion. In either case this illustration gives some idea of the extremely leisurely manner in which great geological earth-movements are evolved. At the present day the Red Sea may be widening and East Africa may be slowly detaching itself from the rest of the continent, but to human eyes the process is not apparent. It is only now and then, at critical junctures, that we find record of a catastrophic change—such as a great volcanic eruption, or a tremendous lava flow—sufficient to effect any suddenly perceptible difference in the earth's surface.

We are now in a position to follow Professor Wegener's interpretation of the evolution of continents and oceans since geological time began. He draws for us a picture of the dim dawn of the geological ages, when the whole surface of the globe was covered by a film of sial one-third of the depth of the present continental crusts. This, again, would have been covered by a world-wide ocean, rather under two miles in depth, which would have left few, if any, portions of the sial-sphere un-submerged. Underneath the upper crust of sial lay the heavier, but more viscous sima.

Later, great rifts occurred in the sial crust and, as the rifts widened, the sima floor of the ocean for the first time lay exposed, while the sial mantle was contorted and contracted so as to occupy only a portion of the earth's surface, with the result that it became considerably thicker. Being lighter than the sima, the thickened sial block rode higher in the viscous sima layer, and, for the first time in the geological history of the earth, extensive land surfaces began to emerge, while the ocean began its retreat towards the lower levels, where the sima floor now lay without any covering mantle. This view rests on two grounds of support. Biologists and palæontologists agree that, in all probability, the earliest forms of life on the earth—whether animal or vegetable—lived in the water. Before the Silurian ages there were no air-breathing animals, and it is not till we come to Devonian times that there is any marked progress in the adaptation of the *flora* and *fauna* to terrestrial conditions. The second ground is purely geological : the oldest rocks, wherever found on the earth's surface, are always strongly folded and contorted. No Archæan rocks can be found in which the original stratification is undisturbed, and it is evident that, if we could smooth out all the folds and contortions, these rocks—

Fig. 1

Upper Carboniferous

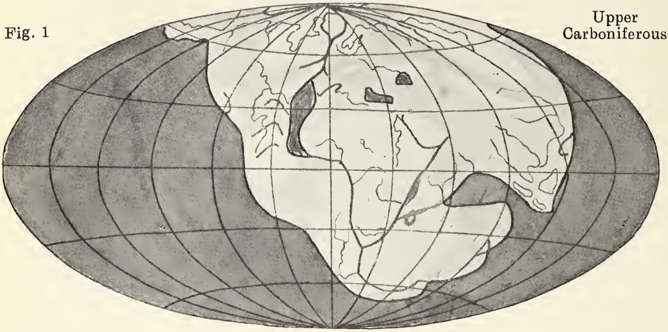


Fig. 2

Eocene

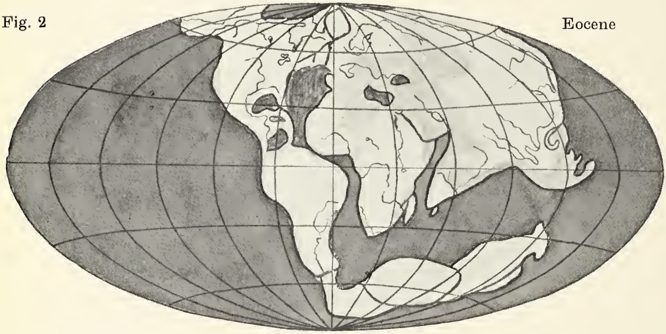
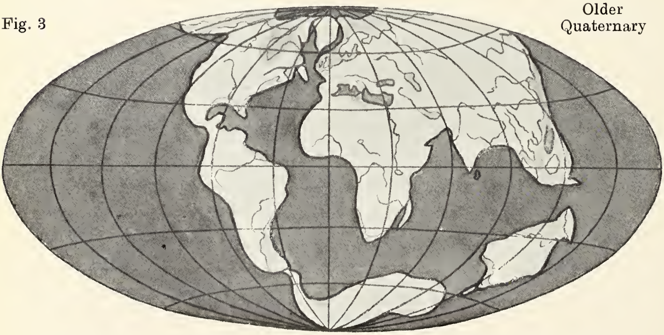


Fig. 3

Older Quaternary



The Origin of Continents and Oceans according to the Displacement Theory.

Reproduced from Wegener's "Origin of Continents and Oceans." *By courtesy of Messrs. Methuen & Co. Ltd.*

which everywhere form the basis of the continental blocks—would cover a much larger portion, if not the whole, of the earth's surface.

It is quite conceivable that the foldings and rumplings of the Archæan gneisses were caused by the driftings, which cleared away the sial crust from the area now covered by the floor of the Pacific, probably the oldest ocean, and compressed the sial mantle into the continental blocks which formed the Devonian and Carboniferous continents.

Towards the close of the Palæozoic ages, during the later Carboniferous period, the continental crust had shrunk so as to cover about one-half of the earth's surface, but it still lay in one more or less compact mass somewhat as shown in Fig. 1, *vide* plate. In this figure the present continental outlines are inserted merely for the purpose of identification. The dotted portions of this universal continental block denote the shallow seas, in which were laid down the vast areas of Carboniferous sedimentary strata found over so many parts of the world. The clear areas show roughly the probable land surfaces of this period. You will see that a vast shallow sea stretched from west to east right across the upper part of this continental block, while the main land-surface centres round the counterpart of Africa, which was contiguous on one side with South America. Central Asia then lay at the bottom of the shallow Carboniferous sea. On the east of Africa you will find a greatly elongated tongue-shaped area. The southern portion of this tongue represents the present Indian Peninsula, which even then was a land-surface. The northern portion of the tongue represents horizontal strata about 2,000 miles or so in breadth, which lay along with Central Asia at the bottom of the Carboniferous sea, and which were crumpled up later to form the mighty folds of the Himalayan mountain system. Lapping round Afro-India on the south and south-east lies that part of this great land-mass which represents Antarctica and Australia of the present day.

I may here mention that Professor Wegener closely connects with his displacement theory the assumption that during successive geological ages the positions of the Poles have undergone considerable variation.

Palæontologists are all agreed that the fossil *fauna* and *flora* found in the various sedimentary strata frequently show that these strata must have been laid down under climatic conditions differing widely from those which now obtain in the regions where the strata occur. When, however, they try to work out, from this internal evidence, the climate over the world at any one geological period, they are confronted by the most baffling complications.

Let us take, for instance, the same Carboniferous period of which we have just been speaking. The palæontological evidence from this period happens to be fairly abundant and widely diffused.

In Spitzbergen, inside the present Arctic circle, we find coal-beds containing fossils which were almost certainly deposited under tropical conditions. In the middle of South Africa, some 90° south of Spitzbergen, at almost the same geological horizon, we find deposits showing unmistakeable signs of glacial conditions.

One would at once be tempted to argue for a North Pole somewhere in the middle of the Pacific and a South Pole near the middle of South Africa. It somewhat confuses the problem, however, to find strata of approximately the same age in Brazil, India and Australia which also bear clear signs of glacial conditions. To use the term quite literally for once: where on earth can you fix a South Pole which could account for glacial conditions at approximately the same period in such widely scattered localities?

If you accept the displacement theory and the grouping of the continental masses as shown in Fig. 1 of Diagram F, the puzzle can be solved. The glaciated regions in Brazil, India and Australia group themselves in a fairly close circle round a South Pole placed near the middle of South Africa.

As Wegener points out, physicists are not altogether in favour of any very pronounced variations in the actual axis of the earth, but the apparent wandering of the Poles may be accounted for by relative movements of the continental crust, as a whole, over the more static central core. So far as the continents are concerned, this would give the same result as a shift of the real axis.

There is, thus, considerable force in Professor Wegener's assertion that, so far as concerns the investigation of the climates in former geological ages, the displacement theory does not merely simplify the problem; it rather affords the first possibility of any explanation whatever. Assuming the displacement theory, you can piece out your evidence in any period and find a position of the Poles which will give a rational interpretation. Wegener has in fact worked out tentatively a schedule showing the position of the Poles in the successive periods and is still engaged in further research on this side of the question.

For the succeeding geological periods I must confine myself to a very brief outline of the changes which have resulted in the present position of the continents, before I turn to a slightly fuller examination of the movements affecting the land masses of India and Australia. The first big separation is presumed to have occurred fairly early in the Jurassic period, when the combined block of Australia and Antarctica was sundered from Afro-India by a rift which opened between India and Australia. This rift gradually spread southwards, until in Cretaceous times it cut the southern extremity of South Africa and united with another meridional rift which opened from the south and began to wedge Africa apart from South America. This latter rift, as it spread northwards, was associated with a certain amount of rotation by South America on the hinge which connects it with North America. At the same time an isolated rift, which had expanded earlier between North Africa and Europe on the east, and North America on the west, enlarged itself until it joined the South Atlantic split. At the close of the Cretaceous period the Indian Peninsula began to part company with East Africa; while Australia, Antarctica and South America, still in one land-mass, were drifting further away from both India and Africa.

In the early Eocene, at the opening of the Tertiary Age, the position was approximately as shown in Fig. 2 of the plate. You will see that the Continents are well on the way towards the assumption of their present shapes.

The movements in the Secondary Age had been associated with considerable wanderings of the Poles. In the Permian and Triassic periods the mean position of the Poles was: North Pole, 50° N., 130° W.; South Pole, 50° S., 50° E. During the Jurassic, the Poles moved considerably nearer to their present positions, reverting in the Cretaceous to almost the same positions as in the Permian.

During Tertiary times the distances between the Continents continued to widen and the movements included the disappearance of the vast shallow sea, which until then had covered the surface of the continental block in a wide zone from Western Europe to Eastern Asia. This former sea is known to geologists as the Tethys.

Now, during Tertiary times the mean position of the North Pole lay south of the Bering Straits, and that of the South Pole on the meridian of Greenwich, south-west of the Cape of Good Hope; so that the Tethys lay along the Tertiary Equatorial belt. As I explained earlier, in Diagram E, it would occupy a zone of weakness in the sial crust.

The general trend of the forces which caused the great drifts was in the nature of a double thrust westwards and towards the Equator. The weak crustal zone of the Tethys, lying along the Equator, was thus subjected to converging pressures from both hemispheres, as a result of which it was slowly, but irresistibly, squeezed like a concertina into the vast girdle of mountain chains which runs from the Pyrenees, through the Alps and the Caucasus to the Himalayas and the mountains of China and Mongolia. The bulging shape of the East Asian coast bears witness to the same compression.

At the opening of the most recent geological age—the Quaternary—the general situation is shown in Fig. 3 of the plate. The present grouping of the land-masses has almost been reached; but the forked rift in the North Atlantic, which leaves Greenland as an isolated triangle in the Arctic seas, was still incomplete. Antarctica had just separated from South America, while Australia had still to finish its voyage across the Southern Ocean. The later movements of the Australian land-mass, which includes New Guinea, furnish one of the most fascinating and ingenious examples brought forward by Professor Wegener in the exposition of his theory.

As I stated above, the general trend of the displacements is westwards and towards the Equator, but we cannot thus interpret all the driftings. India, and the earlier movements of Australia seem to have pursued a somewhat different course, carried onwards perhaps by some wide eddying movement set up in the sima.

In order that we may follow more closely these Australian movements, I must first mention yet another of Professor Wegener's arguments. Though the sima is viscous as compared with the sial and allows the continental blocks to pass slowly through it, and though, like water, it is subject in general only to displacement and not to compression and distortion, yet it is in fact so solid as to offer enormous resistance. Consequently, the frontal margin of a drifting continent is contorted by the pressure, and we find long mountain ridges piled up, close to and parallel with the coast-line, in the van of the moving land-mass. Again, in the rear of the mass, comparatively small blocks become detached, and, owing to their decreased momentum, stick fast in the sima to tail out in a lagging festoon of islands. Thus we account for the long ridges of the Rocky Mountains and the Andes, and for the island festoons of the West Indies, Tierra del Fuego, Japan and the Malay Archipelago.

In the earlier stages of its drift, the East Coast of Australia, and New Zealand—which then formed an integral part of the mass—lay in the van. Accordingly we find that at a comparatively early period the mountains of East Australia and the New Zealand Alps were formed parallel to the coast. In later Tertiary times Australia came under the influence of the more normal drift movements and so changed the direction of its advance to the north-west. New Zealand became detached and was left behind as a lagging festoon, while New Guinea, connected with the main block by a continental shelf, probably much broader then than it is now, became the ram-head of the advancing mass, which in quite recent times has thrust itself into the long trailing festoon of the Malay Archipelago.

Prior to this Australian thrust the eastern islands of the Archipelago would have stretched in a symmetrical sequence to the Solomon Islands; but now the islands in the Banda Sea from Timor to the West Coast of New Guinea have been forced northwards and outwards in a backward curve. The same fate has overtaken New Britain on the east of New Guinea. It has been caught by its former south-east end and dragged clean round. The recoil of the thrust has piled up the lofty mountain chains of New Guinea, which are admittedly of very recent formation.

This movement, if accepted, gives by far the most satisfactory explanation of the mystery of 'Wallace's Line', where a series of insignificant straits separates the widely differing faunal regions of Australia and South-East Asia. The two distinctive lines of evolution were developed during the period when the two regions lay parted by a wide expanse of ocean. It is only in recent times that they have been brought into juxtaposition by the north-westerly advance of the Australian Continent.

Let us now turn to India as a final illustration of continental displacement and as one which interests us the more closely. Wegener is very general in his treatment of this movement and, in order to present the evidence and conditions a little more fully, I have had recourse to Professor Wadia's *Geology of India*. This is a fairly recent publication, which ably summarizes in text-book form the general results of the very large amount of valuable work carried on for three quarters of a century by the Geological Survey of India. Published in 1921, this book contains no reference to the displacement theory, and the author clearly upholds the older theory which assumes the foundering of Gondwana-land *en bloc*. Evidence, therefore, taken from this source, of the internal geological history of India is certainly not biassed in favour of Professor Wegener. I am also indebted to Mr. Hunter, Inspector of Mines in Ceylon, who recently visited Madagascar, for placing evidence at my disposal concerning the geology of that island.

If we glance backward to Fig. 1 of Diagram F, we see that it represents the Indian Peninsula—with Ceylon like a little knob at the end of it—as lying alongside of Madagascar and East Africa in one solid mass. On the east of this mass Australia formed the outside portion of the huge universal continent. This represents the state of affairs at the close of the Carboniferous period, when the South Pole lay somewhere in the region of Mafeking. The Indian Peninsula then formed part of a great inland plateau, the southern portion of which fell within the Antarctic circle and was presumably covered by a great cap of ice.

I have mentioned earlier in this paper that Professor Wegener remarks on the similarities in the diamond-bearing rocks of Brazil and the Kimberly region, and uses this fact in support of his theory. There is an analogous parallel in the composition of the Archæan gneisses of Ceylon, South India and Madagascar. In all three countries graphite and gems are found occurring under very similar conditions in these Archæan strata.

We find, too, in the Indian Peninsula an extremely interesting sequence of sedimentary rocks, laid down at intervals between the later stages of the Palæozoic and the close of the Secondary Ages, and known as the Gondwana system. It is this system which has given its name to the 'lost continent' of 'Gondwana-land', inasmuch as these deposits find parallels in Madagascar, East Africa, Australia and South America—the regions which adjoined the shores of this supposed, far-spread, lost continent. The fossil evidence of the Gondwana strata in these widely separated regions gives extremely clear proof of similar conditions in all of them over a long period of geological time. The outstanding fact in the whole of this great series is that they are not marine strata, but were laid down in river valleys and lakes.

Professor Wadia speaks of the Indian Gondwana rocks as having been deposited 'in slowly sinking faulted troughs into which the rivers of the Gondwana country poured their detritus'. In other words, these Gondwana strata originated under precisely the same conditions as the alluvial and lake deposits which are being formed at the present day in the African Rift-Valleys. The earlier beds contain boulders striated in the unmistakeable manner which tells of glacial action; in the succeeding strata we have evidence of a climate which gradually became warmer.

We have therefore very strong grounds for assuming that these strata point to a close parallel, in a colder climate, with the conditions which now obtain in East Africa; and it is more intelligible to assume that these similar conditions were confined to a land-mass of reasonable size, grouped round a South African Pole, than that they were spread over an area almost equal to a complete hemisphere.

We can picture the Rift-Valleys beginning to form in late Carboniferous and Permian times, and developing through the Secondary Ages, until we come, in the early Jurassic, to the first rift which completely sundered the sial crust and resulted in the severance of Australia from Afro-India. The critical stage of a rift is generally accompanied by great lava flows in its vicinity, and we do find evidence of a Jurassic lava flow associated with the uppermost Gondwana beds in the Rajmahal hills of Bengal. The Palæontological evidence argues for a separation of Australia from Afro-India towards the middle of the Jurassic, and it is not until we come to the upper Jurassic that we find any marine strata on the east Coast of India. We have, therefore, three important lines of evidence, which agree in dating the severance of Australia and the formation of the coast-line on the east coast of India at about the middle of the Jurassic period.

After this severance, the rift-movements in the interior of the Afro-Indian land-mass appear to have died down for a while, and a period of comparative quiescence seems to have set in, which lasted until the end of the Cretaceous. We get a certain amount of subsidence along the east coast of India reflected by marine deposits of late Jurassic and Cretaceous times at various places on the eastern side of the Peninsula. The present west coast of India was not then in existence as a coast line.

By looking at present-day East Africa we may form a very clear idea of the conditions which obtained in the Indian Peninsula, just before the great split, at the close of the Cretaceous, severed it from the African continent. The present west coast-line of India might quite possibly have been represented by an incomplete rift, corresponding to the African rift system. On the eastern side we would have a fairly old coast-line with marine deposits, of upper Jurassic and earlier Cretaceous times, which would correspond to the marine, Tertiary, deposits at present found on the East African Coast. The main river drainage would face the east, so that the rivers would gradually cut back the line of their water-shed further and further to the west. These conditions would explain why the water-shed in the Indian Peninsula lies so far to the westward. You would have exactly the same phenomenon in the Continental block which would be formed if Africa, east of the Rift-Valleys, were to be separated from the rest of the continent.

Somewhere about the close of the Cretaceous period we come to the tremendous earth movements which split the Indian Peninsula from Africa and sent it voyaging across the ocean to its present position. Indian geologists are fully agreed as to the approximate date, and the tremendous effect upon the internal geology of India, of this great movement. It began with the vast series of lava flows which poured over an enormous area of the Peninsula. The rocks which form the denuded remains of these flows are known as the Deccan Traps. They still cover over 200,000 square miles in Bombay and the Deccan. Their total thickness reaches 10,000 feet on the Bombay Coast, but thins down as the strata stretch outwards from this centre. These trap-rocks date from the close of the Cretaceous to early Eocene times. We have similar huge flows of the same date forming great plateaux in East Africa and Madagascar.

Indian geologists further agree that the west coast-line of the Peninsula assumed its present form in connection with this great movement. As evidence we have the fact that not until we reach Pliocene times do we find any marine deposits on the west coast of the Peninsula proper. Wadia would attribute the present outline of the Indian west coast to the foundering of that part of Gondwana-land which lay between India and Africa.

Lastly, Indian geologists agree that up to the close of the Secondary period the Peninsula proper was washed on the north by the waters of the Tethys; and that in Eocene times the sedimentary strata, laid down at the bottom of this wide, but shallow sea, began to be compressed and elevated into the great mountain system of the Himalayas.

The whole process falls into three main phases. The first began, as I said, in the Eocene, not long after the occurrence of the Deccan lava flows. This phase ridged up the central axis of the system; the second phase at the end of the Miocene accounts for the inner lesser ranges; the third and last phase completed the process by a further elevation of the earlier zones, and also by the creation of the outermost southern range of the Siwaliks. This last phase did not come to an end until almost the very close of Tertiary times.

As in the Alps, so in the Himalayas, the sedimentary rocks which now form the mountain slopes have been compressed and contorted in the most extraordinary manner. If we compare the size of the Himalayan system with that of the Alps, and consider that the Alpine strata, when folded out smooth and flat, would occupy a zone 400 miles, or even more in breadth, we can easily understand that the Himalayan strata, if flattened out, would require a zone of 2,000 miles or more, a breadth which would be sufficient to make the extremity of South India reach Madagascar. We must remember too that, on the principle of isostasy, the sial crust floats in the sima with only about one-eighth of its bulk un-submerged. In consequence seven-eighths of the total effects of any compression are expended downwards, so that what we see in the Himalayas of the present day is only the denuded remains of one-eighth of the total results of the stupendous movement which resulted in their formation.

It seems to me that the displacement theory gives a more intelligible account of the movement than a theory which assumes the vertical foundering of Gondwana-land, and so fails to make any adequate allowance for the enormous horizontal compression which must surely have accompanied the elevation of a mountain system so vast as the Himalayas.

According to the displacement theory India and Africa were united until the critical rift occurred at the close of the Secondary Age. The lava flows of the Deccan and East Africa would form parts of the same great series of outbursts which occurred in the vicinity of the rift, and would thus be brought into close relationship with each other in space as well as in time. When the rift had completely opened and the drift of India began, the upheaval of the Himalayas may be described as a concertina-like compression of the floor of the Tethys, which fore-shortened India and allowed for the ever widening gap between that country and Africa, until the movement was completed.

I have noted above that this Indian drift does not partake of the normal double movement westwards and towards the equator. We must remember, however, that in Tertiary times the equatorial line lay more or less along the central axis of the Himalayas, and Wegener considers that, on the whole, the movement may be interpreted as a drift towards the Equator. The eastern element in the directing force may perhaps be due to some great eddy in the sima. Whatever the force may be, it seems to have acted fairly constantly in this region of the globe; as Madagascar which, from the geological and zoological evidence, appears to have separated from Africa at a much later date, is following in precisely the same direction. If we liken the map, once more, to a jig-saw puzzle we can, without any hesitation, fit Madagascar on to the East African Coast some degrees south-west of the position which it now occupies.

In conclusion: If we admit the theory we must also assume that the forces which cause the continental movements are continuous and are even now in operation. Wegener is confident that, in the case of Greenland, this can be proved by a series of longitudinal determinations taken in 1823, 1870 and 1907. These, he maintains, show that Greenland has moved about one mile westwards between 1823 and 1907. Dr. Evans, however, in his introduction to Wegener's book, points out that everything depends on the accuracy of the determinations, which were taken by observations on the moon. The general opinion is that in lunar observations we cannot depend on an accuracy sufficiently meticulous as to prove such slight variations. By means of wireless telegraphy, however, extraordinary accuracy can now be attained, and a similar series of wireless observations, over a period of fifteen or twenty years should enable us to obtain a definite verdict.

Further, as regards the nature of the forces which have caused and are now causing the continental displacements, we must confess with Wegener that the question is still too much in a state of flux to admit of a complete answer satisfactory in every detail.

It is a matter largely for the mathematician and the physicist, and I regret that I am not sufficiently versed in the learning of either to attempt a summary which would present in a condensed and simple form the substance of Professor Wegener's arguments in his chapter on these displacing forces. However, as I said before, he makes out that there are two main forces at work: one impelling the masses westwards, and the other directed towards the equator. The westward drift may be explained, as are the tides, by the attraction of the sun and moon. A certain degree of the equatorial movement may be accounted for by the force of gravity acting on the Continental masses as they float in the sima with their centre of gravity lying above their centre of buoyancy. He admits, however, that this latter force would not be sufficient of itself to explain the elevation of the equatorial mountain chains. He surmises that an additional force may be found in the wandering of the poles, coupled with the flattening of the earth at the polar axes.

The radius of the earth at the poles is about sixteen miles less than at the equator. If, therefore, the poles wander to any great extent, say, to the latitude of 60°, the surface of the earth in the new polar positions would, for the time being, be several miles too high. But, since the globe behaves as a slightly viscous body, in course of time the surface of the earth would flatten out round the new polar positions and regain its proper bulge over the areas where the poles formerly lay. Wegener considers that in this deformation of the earth's figure, caused by the wanderings of the poles, we have a source of power sufficient to do the work of folding.

Finally, in appraising the theory, we must remember that in so many cases it is much easier to demonstrate the manner in which things happened than to explain the cause.

Darwin had a firm conviction in the theory of evolution, and in order to explain it, hit upon the solution of 'natural selection'. He was unaware of Mendel's Law, which was worked out only six years after the publication of the *Origin of Species,* and he probably did not attach sufficient importance to the influence of environment and isolation in directing evolution along a more or less definite line.

Within a few years the scientific world had accepted the grand fact of evolution with all its manifold implications; but biologists are still in dispute over the parts played by selection, mutation, or environment, in the actual processes of evolution.

To use an illustration on a different plane: We may compare Wegener's exposition of his theory with the reconstruction of a criminal affair by a detective. He has, as it were, pieced together in a brilliant and convincing fashion fact after fact of circumstantial evidence, until all the details in the commission of the crime stand out vividly before us, but he has not as yet proved conclusively the identity of the criminals.

The position may be summed up fitly by a quotation from Dr. Evans' Introduction to Professor Wegener's book: 'Whatever may be the outcome of these observations and whatever modifications may prove to be required in the author's views on the evolution of the present configuration of land and sea, he has done most valuable service in directing attention to a new and important element in the transformations that the world has suffered, an element which no one, henceforth, will be able safely to ignore'.

Table of Geological Periods

Quaternary ...	Recent
	Pleistocene
Tertiary or Cainozoic ...	Pliocene
	Miocene
	Oligocene
	Eocene
Secondary or Mesozoic ...	Cretaceous
	Jurassic
	Triassic
Primary or Palæozoic ...	Permian
	Carboniferous
	Devonian, and Old Red Sandstone
	Silurian
	Cambrian
Archæan ...	Fundamental Gneiss.

ON THE NESTING OF THE CRESTED SWIFTS

BY

H. WHISTLER, M.B.O.U., F.Z.S.

(*With two plates*)

We have to thank Mr. H. Van Meurs for a copy of an article which he has recently published in the *Orgaan der Club van Nederlandsche Vogelkundigen* on the nesting of the Malayan Crested Swift (*Hemiprocne longipennis*). Unfortunately we are unable to read the whole of what is evidently a careful and detailed account owing to our ignorance of the Dutch language but the author has appended a brief summary in English which allows us to gather the purport of his article. As an English footnote shows us his article is entitled 'A nidological problem requiring solution. The enigmatical system of procreation of *Hemiprocne longipennis*'. It is illustrated by some excellent photographs of the remarkable nest of the Crested Swift and of the young bird in various stages sitting on or near the nest. But before we examine his conclusions we should perhaps give some account of the Crested Swifts and their remarkable breeding habits.

The Crested Swifts have been separated from the other and better known members of the Swift family (*Micropidæ*) as a sub-family *Hemiprocninæ* on account of the characters of the tarsi and feet which show strong affinities with those of the Swallows. In appearance also the Crested Swifts resemble the Swallows far more than the Swifts. They are very beautiful birds of a Swallow-like build with their long pointed wings and long deeply forked tails. The plumage is soft and silky like that of the Swallows as contrasted with the hard oily plumage of the Swifts. The feathers of the forehead are long and erectile, forming the crest to which the group owes its name. The feet have the hind toe non-reversible, that is to say, they share the normal arrangement of three toes in front and one behind found in the Swallows and other passerine birds as contrasted with the Swifts whose reversible first or hinder toe enables all four toes to be used for climbing rather than perching.

The new edition of the *Fauna* admits three forms of Crested Swift in the territories of the Indian Empire. These are the Indian Crested Swift (*Hemiprocne coronata*), the Malayan Crested Swift (*H. longipennis harterti*) and the Tufted Tree-Swift (*H. comata comata*). All appear to have much the same habits. They are birds of well-wooded country where they are found in small parties which hawk about for insects with a wheeling flight which far more resembles the flight of a Swallow than of a Swift. But the characteristic which separates them far more than any other from the true Swifts is the fact that they perch on trees. A bird-observer who met a party of these birds for the first time in the

NESTING OF THE CRESTED SWIFT (*Hemiprocne coronata*).

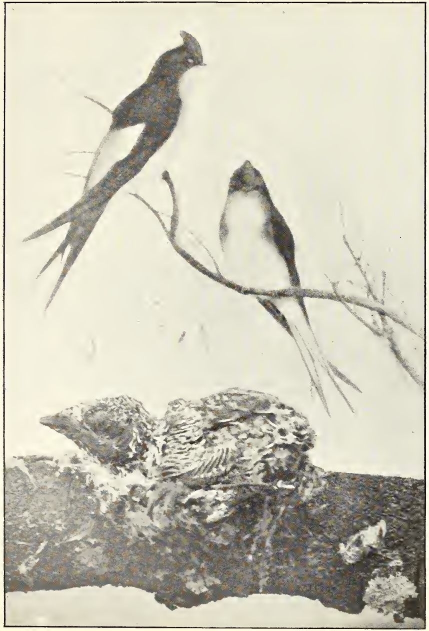


Fig. 3. A young Crested Swift in its nest (nat. size).
Adult birds are shown in the background.

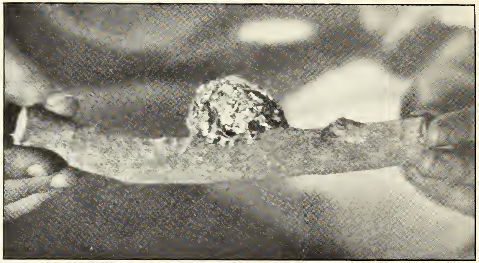


Fig. 1. The bottom of the nest.

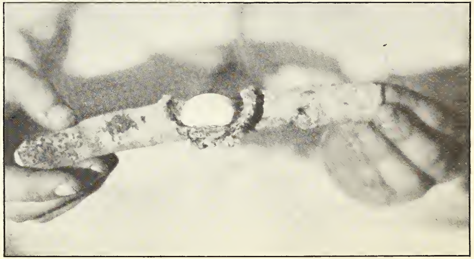
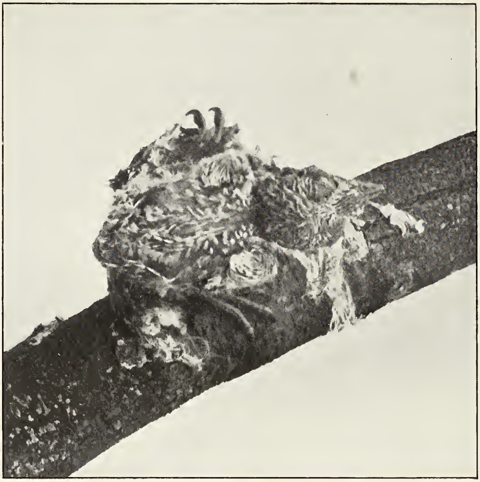
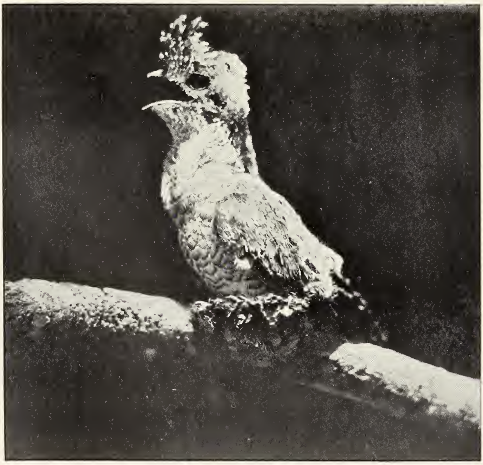


Fig. 2. Nest and egg.

NESTING OF THE CRESTED SWIFT (*Hemiprocne coronata*).



The nestling in a defensive pose.
A study in a mimicry.



A young Crested Swift.

forest could hardly be blamed, in short, for thinking them Swallows as he watched them settling on a dead bough at the top of a tree, and launching off at intervals to hawk for midges with a graceful wheeling flight. On a bough the Crested Swift sits very upright with its crest erect; and it utters freely a loud screaming cry which is certainly not characteristic of a Swallow . The most curious part of the Crested Swifts is their nest. It is worth while quoting Hume's graphic account of the nest of the Indian Crested Swift which serves well enough for a description of the nests of the other two species. He says: 'The nest is a most wonderful little structure. It is a very shallow half-saucer, composed of thin flakes of bark, gummed, probably by the birds' own saliva, against the side of a tiny horizontal branch. The nest is nowhere more than ⅛ inch in thickness, is at most ½ inch deep in the deepest part, and can be exactly covered by a half-crown. The parent bird, though slender, is fully 10 inches in length, and consequently the bird, when sitting across the nest and the tiny branch to which it is attached, completely hides the nest and no one would suspect that there was any nest there at all.'

This nest is entirely filled up by the solitary rather large greyish white egg which is a very elongated oval in shape, obtuse at both ends. Seen from below the nest appears to be merely a knot on the bough and its colour—black as a whole with small grey or dirty white blotches—exactly matches the bough. Such a nest is of course impossible to find except by watching the bird to it, and even when found it is difficult to be sure of the fact as the bird appears to be merely perching on the bough although in fact brooding the single egg in its tiny case. Although sometimes built at greater heights from the ground the nest is usually from twelve to twenty-five feet up and as the bough selected is thin and often dead the nest and egg is very difficult to secure.

Mr. Van Meurs' paper appears to be devoted to a very elaborate analysis of this method of nesting in the Malayan Crested Swift. We must quote his English summary and conclusions:—"In this essay the author shows that,—where *Hemiprocne longipennis,* like so many other Indian Swifts, builds a nest of the Swallow-nest type (viz., stuck to something sideways) but builds it in trees, not under a covering, which has to protect the nest from getting wet and falling off,—*the nest of this bird must necessarily be so small that it* (*i.e., the bird*) *can entirely cover it, and, by doing so, can itself form the required covering.*"

From this it follows that this very elaborate nidological system has probably not arisen in an evolutionary sense, but must have come into existence suddenly and quite complete. This is i. a. suggested, as the author proves, by the very definite construction required for the building of this miniature nest, which construction cannot have developed gradually from another construction.

We quite agree with Mr. Van Meurs that there must needs be some special explanation of the curious nests of the Crested Swifts, and we would agree that their most outstanding characteristic is the fact that they are so far as we know the smallest nests built by any group of birds, smallest, that is, in relation to the size of the builders; but we are not certain that the writer has hit on the true explanation of the size. Whilst we certainly do not feel satisfied that these nests have been suddenly created as a new invention rather than evolved from other types of nests.

To take the deduction first, it seems to us that the nest of the Crested Swift is merely a logical and not unobvious development of the type of nest that runs throughout the family of the Swifts. Now there is one characteristic that runs through practically all the nests of the various members of the Swift family, namely the use of the bird's own saliva. The extent to which saliva is used varies considerably. In the genus *Micropus* it is merely used to cement together the feathers and fragments of straw and grass which form the nest material proper. In the smaller genera such as *Callocalia* practically the entire nest is composed of saliva to such an extent that, as is well-known, in various Indo-Malayan countries the nests are used by the native races for 'bird-nest soup' and form a regular article of commerce. Another character that runs through the nests of the family is adaptability of shape and site. One has only to examine a colony of nests of that common Indian Swift, *Micropus affinis* to find that although the birds perhaps normally prefer to make a huge semi-globular nest plastered under a ceiling or rock, they are ready enough to lighten their labours by profiting from the presence of an old Swallow's nest or a hole in the sheltering surface : in such cases the amount of saliva and construction is reduced considerably by the circumstances of the site; it is sometimes reduced almost to vanishing point. The Swift is clearly in its nesting arrangements an adaptable bird and good material for evolution to work upon. In the genus *Callocalia* we see the result of such evolution. The use of saliva has attained to practically its maximum. The nests of this group are remarkably true to type, small shallow saucers attached by one side to the roofs and sides of caves and sometimes inside buildings. The nests vary in the proportions of saliva and extraneous materials. In some forms and individual nests the nest is largely composed of moss, lichen, sea weed and similar substances. In others the nest is practically composed of saliva with the addition of but a little material. With this genus the evolution of the Swift's nest has reached one limit of its evolution; the shape is fixed; the saliva is almost the dominant material and the birds have highly developed glands beneath the chin for its production.

In the Palm-Swift (*Tachornis batassiensis*) another line of evolution has been fully exploited. As its name suggests this quaint little Swift has become practically a parasite on palm-trees, and in response to this parasitism its nest is very highly specialized, never built anywhere except on the leaves of certain species of palm. This peculiarity reaches its maximum in the Eastern race, *T. b. infumatus* which builds also in the roofs of the Naga villages where the houses are thatched with double layers of palm-leaves. Incidentally where palm-leaf thatching has given place to thatching with double-layers of grass or bamboo leaves the Swifts still nest in the roofs. The nest in its typical form, placed in a palm-tree, is thus described :— 'The nest is a tiny purse of light down, very often of the *Bombax*, matted and twisted together but very soft except at the rim and back. The rim is stiffened with saliva into a sort of cord, strong enough to bear the weight of young and old, whilst the back is saturated with saliva and thus firmly glued to the palm-leaf.'

Now it will be remembered that all these Swifts, however they nest, have one common characteristic in their curious feet—feet which do not allow them to perch in the manner usual amongst birds—and in the proportions of their wings and bodies highly specialized for strong and rapid flight. All these Swifts are fliers and nothing else. They have the shortest humerus and longest manus of all known birds. They cannot perch like other birds; they can only cling to an upright surface or shuffle into a hole. The normal position of a Swift in its nest is probably semi-upright. They must nest so that they can fling themselves straight into midair and open the long wings with no fear of striking them against anything. The Palm-Swift has only taken to the palm not as a tree but as affording a series of miniature caves amongst its curling fans. This is well illustrated by Thompson's account of a breeding colony in the Mirzapoor district. 'On a Toddy-palm' he says, 'I observed several nests. With some difficulty I got one down with two eggs. . . The nest was stuck between two ribs of the leaf of the palm, and the female bird looked as if she was sitting up against it—so small did the nest look, and such the apparent uncomfortable attitude of the occupant. Near the nest was a colony of Bats (*Nyctecejus castaneus*). I killed out of the lot in one shot 21 bats. The palm was alive with them and with the Swifts. I noticed these birds clustering on the leaf of the palm between the ribs of the fronds. When moving up and down they crawled with a shuffling kind of motion, as if their legs were too short for progression.'

In this case it is interesting to notice the analogy between the bats and the Swifts. Both were in the palm tree in the manner of their relatives in buildings. It happened to be a tree they were living in but only because it was the sort of abnormal tree which afforded an approach to the normal requirements of the two families. They could not have lived in the leaves of a normal tree with only twigs to perch upon.

The Crested Swifts, however, have ordinary perching feet, with three toes in front and one behind. They live on trees and hawk from their branches, just like innumerable species of a host of other families. It is not strange therefore that they follow the example of most other birds that nest in the trees in and around which their lives are led. They retain however the family characteristics of adaptability in the place and shape of the nests and in the use of saliva; the nests are of the shallow adaptable saucer type which we have seen that other members of the family cling to under varied conditions. The only real change in the nest is that it is very small and that it is placed in the open on the side of a bough. It seems to us far easier to consider the nest as an adaptation of the family nest than as a new creation. After all if the Swift is to nest in a tree at all, it has not much choice of sites. The nest must be within a hollow trunk or bough like those of some of the Spine-tail Swifts, it must be plastered against the trunk or the side of a branch, or it must be built like an ordinary nest amongst the branches or leaves. We think the build of the Crested Swift probably negatives the first two possibilities; the soft long forked tail and the shape of the feet prevent the bird climbing in and out of holes like the other Swifts; and the same factors would militate against a saucer nest against the trunk. To sit in the uncomfortable attitude of the smaller Swifts all pressed up against the trunk, with the throat and breast against it, surely requires their reversible hind toe. To sit in the nest after the normal fashion of passerine birds—as for instance the Grey-headed Flycatcher (*Culicicapa ceylonensis*) in its mossy nest against a tree trunk is rendered awkward by the long wings and tail, awkward that is at the moment of entering or leaving. To build on a bough or amongst the branches would no doubt be the easiest way for the Crested Swift. But we suggest that it builds its little saucer against the branch and not on it simply and solely because of the strong inherent tendency that runs through the nesting habits of the family. It builds the little saucer against the bough not 'suddenly' in Mr. H. Van Meurs' words on a sudden inventive impulse of its own, but because it is a Swift with an inherited 'evolutionary sense' which makes it build such a nest as part of its heritage. That the nest should be small appears to us to be due to no special need of protection from rain. For after all innumerable nests of innumerable species are built on boughs in open situations and many of them are just as vulnerable to rain as the nests of the Crested Swifts and yet remain of normal size. It seems to us that the nest of the Crested Swift is very truly an evolution. It has shrunk because there is no particular point in its remaining large and many points in favour of its becoming small.

To put the point succinctly: The Crested Swift has the inherited tendency to build the family nest, a shallow saucer stuck to something sideways, with saliva one of its important constituents. The circumstances of its life and form decide that the nest should be stuck to the side of a tree bough. Such a nest in such a site has to withstand a tremendous strain of pressure and will obviously be safer in proportion to the degree of diminution of its size. For the bird to settle on it in a position crossways with the branch is the obvious method of convenience in alighting, and to let the branch take some of the bird's weight is no out of the way arrangement. Once these two points are gained there is no point in the nest remaining large. For it to shrink is an economy of strain, of work and of material. And so to us it is far easier to believe the nest of the Crested Swift an interesting example of evolution than to find it a sudden invention created independently as a means of avoiding the rain. We may not find it possible to agree with Mr. H. Van Meurs in his conclusions, but at any rate we are grateful to him for calling attention to and, as it were, underlining an interesting problem. Any of our members who are in a position to observe the Crested Swifts in life might well pay attention to the problem and see if there is any other explanation than the ones that have been thus suggested. While a further point of interest, and possibly one that holds a key to the explanation, is to remember that in the Nightjars (*Caprimulgi*) and Frogmouths (*Podargi*) we have a somewhat similar situation. The Frogmouths leave the normal nesting habits of the Nightjars to which they are closely allied and build a disproportionately small nest on a bough or branch—a nest that at first sight seems very strange for a bird of its Caprimulgine affinities. Nightjars and the Swifts are closely related.

THE STINGING CATERPILLAR.
(EUPROCTIS ICILIA)

BY

MAJOR R. W. G. HINGSTON.

(With 5 text figures.)

Fabre, in his narrative of the Arbutus Caterpillar, tells of the dread which the villagers have of it. The wood-cutters, the faggot-binders, the brushwood-gatherers all join in the same tale that the caterpillar attacks with great severity, so much so that they spend a night in torment, tossing as if on live coals. The great observer seems a little doubtful of their talk. 'Do they exaggerate,' he asks. He frequently handles the caterpillars himself. He puts them on the tenderest parts of his body, but he never suffers the slightest inconvenience. He applies them to the delicate skin of his child. The result is the merest superficial irritation, nothing of the torment which the wood-cutters describe.

Here, then we have a little problem. Are these caterpillars really terrible tormentors, or have they been falsely accused ? Let us turn to one of our Indian species and examine the actual facts.

One evening in July, while walking in my garden, I happen to come across a cluster of caterpillars belonging to this so-called urticating or stinging group. Science tells us that their technical name is *Euproctis icilia*, Stoll. I find them on the bark of a Phalsa tree. They are quite inconspicuous, though clothed in long hairs, a mottled grey and brown covering which blends well with the underlying bark. They are worth investigation for two reasons ; one, to observe their manner of development, and the other to test the problem before us. Are they venomously armed or not ?

DEVELOPMENT

First, we consider their mode of development. I imprison the cluster in a glass-covered box. The caterpillars, being large, soon pupate, and in two weeks I have the adult moths. They are quiet creatures, seem as content as did the caterpillars with their prison, and make no attempt to fight through the glass. They seek no food for they have no feeding mouth-parts. All they want to do is to sit still and wait for the one event of life. This takes place a day or two after their emergence. I find them then in the act of mating, a prolonged affair, lasting many hours, with no show of enthusiasm about it, and followed, soon after separation, by a profuse discharge of eggs.

These are laid in a cluster on some suitable support. When the business is over, they make a yellow heap wrapped in a quantity of minute hairs. The source of these hairs is very interesting. They are stripped by the mother from the tip of her abdomen. There she possesses a specialized tuft from which she manages to pluck the wrap. The hairs are yellow, thin and delicate. Round the eggs they form a downy vestment, and so carefully is this covering made that not only do the hairs enclose the cluster but they also spread into its interstices and form a separate capsule for each egg. There is no viscid material in the cluster. All the eggs are kept together by the interweaving of individual hairs. Each egg in the composite mass possesses its individual nest. The eggs are not arranged in any special manner. In one place the cluster is a flat layer, in another an irregular heap. When divested of the wrappings, the eggs are almost colourless. Small hard spheres with a smooth, delicately pitted surface, they glisten with a faint lustre like a heap of tiny beads.

The eggs hatch on the sixth day. The new-born caterpillar is, of course, minute. Four hours after birth it measures one-seventh of an inch. It is pale in colour, with a brown head and a number of dark spots on its back. Its whole body bristles with hairs, not just a sprinkling as in many young caterpillars, but well developed radiating tufts springing from its back and sides. Its body shows a few faint markings. Behind the head is a brown patch with a yellow spot on each side of it. There is also a yellow blotch on the tail, and two raised brown spots on the back which later will support specialized hairs.

When first born, the caterpillars are very active. They begin life by making explorations, climbing over the heap from which they have escaped, thrusting their heads into the fluffy mass, scattering the hairs in all directions, rooting into the interstices of the hairy capsule in order to get at the egg-shells inside. This is their first attempt at feeding, a combined effort of the whole family to engulf the egg-shells from which they emerged. Succeeding in this, their instincts change and they commence to nibble at a leaf. Of course their first efforts are very feeble. All they do is to tear off the finest layer of epidermis, leaving behind some yellow specks showing where this cuticle has been eaten away.

The next morning I find the family more scattered. The hairy heap has been dug out, the egg-shells have gone, nothing but a scattering of fluff remains. The caterpillars are all over the leaf. Their colour has grown a little darker and their body markings are more distinct. The problem arises, how are we to feed them ? The cluster I had found was on the trunk of a Phalsa tree, so first I try them with Phalsa leaves. But these will not suit their particular taste, nor will leaves of the Imli, the Ber, the Rose, all of which grow in the vicinity of where the original cluster was found. I feel sure that the family will die of starvation, when by mere chance, in these gastronomic testings, I happen to give them a sprig of Babul, *Acacia arabica*. This evidently suits their taste. They soon climb on it, get in between the leaves, attack their edges, excavate them semicircularly, and end by stripping them completely from the stalk. Thus is the family saved from starvation; and, no doubt, under the natural conditions, this acacia is their accustomed food.

By the third day they are quarter of an inch long. Their bristles are already showing signs of specialization. Each is no longer a plain straight hair. It has changed into a central acute pointed shaft with an encircling armoury of spines. This is the foundation of that delicate machinery which becomes of such importance at a later date. On this day or the next the skin is shed. A rent occurs behind the head, and the caterpillar, little changed in appearance, comes out in a fresh coat. Every fragment of the integument is changed, even the delicate microscopic barbules have their thin coverings renewed. Later we shall see how complex are these hairs, and will realize how perfect is the act of desquamation which permits these hairs, without the breaking of a barbule, being drawn from their intricate sheaths.

The sixth day shows the caterpillar a little larger. It now begins the dropping dodge, falling, when disturbed, on an invisible thread and swinging suspended from its leaf. Also it is getting more attractive in appearance; its pigment is collecting into longitudinal streaks and its early coat of tufted bristles is changing into silky hairs. With undulating movements it crawls about the foliage, having only two objects of any importance, feeding and casting its skin. A dangerous feature is the development of cannibalism. One by one the members of the family disappear. Some happen to be smaller, more undeveloped than others, and these less fortunate individuals are devoured by the monsters that grow at their expense. The loss of life in this way becomes really serious. On the forty-fifth day only four survive out of the family of twenty-six.

The seventh week finds them fully developed. They are brown in colour, mottled with grey, about one and a half inches long. A fringe of long hairs decorates each side. From the back projects a similar armoury, but the hairs are there shorter and thicker and are ornamented with snow-white spots. As is usual in this family, *Lymantriidæ*, the caterpillar possesses some specialized hair-tufts. In this species there is a double pair on the back at the junction of the front and middle thirds of its body; also another similar pair just a little in front of its tail.

Now we come to the pupal change. The caterpillar gets into the nearest debris, spins about its body an open network, nothing very skilful about it, just a mere reticulation of threads. Safely inside, it undergoes a shrinkage. Its hairs drop off and leave a bare skin which soon hardens into a kind of case. It this way it lies dormant for about two weeks. Then the case bursts, and out comes a small

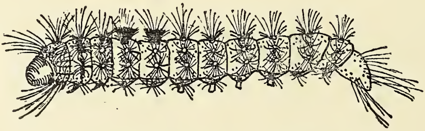


FIG. 1. Catterpillar clothed in Urticating Hairs.
Use.—Urticating.

and fluffy moth. The apparition is a little surprising, the moth is such an insignificant production compared with the caterpillar that gave it birth.

URTICATION

If the reader has persisted through these tedious details, it may, perhaps, be worth his while to examine the caterpillar's poison-discharge. I recall a day when, ignorant of this insect, I happen to take one in my hand. Being interested in the defences put up by these creatures, I drop it in the midst of a swarm of ants in order to see how it wards them off. Nothing worth mention happens in the swarm, but soon I begin to feel an itching. It commences on the neck, just a slight irritation, nothing more than a mosquito-bite. I scratch it. The discomfort increases. The tingling spreads round the neck and down along the front of the chest. Then the forearms begin to smart. Clearly this is no local irritation, but something with a wider effect.

I examine the tingling patch. An intense erythema is rapidly developing. The skin is bright red and beginning to swell. There is a central inflamed spot and round it a crop of angry points. Fresh crops appear in different places. Soon the whole chest and abdomen are involved. New eruptions develop on the legs and back, and soon the whole body burns madly with one incessant itch. It becomes impossible to refrain from tearing at it, though this, of course, intensifies the torture and drives the poison still deeper into the flesh. I am almost beside myself with rage and irritation. Fortunately there is a river handy. Throwing off my clothes, I rush into the water. Some relief is given, only a little, for the painful burning still continues and at times the itching grows intense. Almost every part of the body is involved. The hands and face have escaped from the thickness of their skin, and for some reason the middle of the back is immune. The original red patches have grown into lumps, painful whitish wheals.

In half an hour the main intensity of the inflammation lessens. I dread to put on my clothes again. They must certainly be infected with the poison hairs, and the torment will commence anew. However, there is no alternative. On they go, and I rush for home. The distance is no more than half a mile, but I have not gone a hundred yards when the mad irritation breaks out afresh. Scratching and tearing at it, I again throw off my clothes and plunge into a cold bath. This again provides some temporary alleviation. Methylated spirit gives the final remedy. I rub it thoroughly all over my body, and in fifteen minutes the irritation subsides.

One could scarcely believe that a single caterpillar would be capable of causing such unendurable discomfort. How subtle must be the venom, and how marvellous is the creature's capacity of spreading its poison far and wide! An attempt to relieve it only scatters it farther until the whole body gets involved. I keep up the application of spirit to the patches. Yet, in spite of it, the urticaria persists for days. Patches of redness remain in the skin. Fresh outbursts of irritation develop and require more spirit to keep them down. Even after four days of treatment, it is necessary to apply the spirit at night. How does this simple remedy act? I suppose by neutralizing or destroying some poison. How, otherwise, could it give such immediate relief? The torment, in the absence of this remedy, would be terrible. Then could the wood-cutters truly state that they passed their nights 'tossing and turning as though on a bed of live coals'.

Surely we have here a magnificent defence. A poison which will drive a man to madness must be of value against many foes. But I foresee what might be thought to be a serious objection. The poison is distinctly delayed in its action, therefore the caterpillar will have been destroyed by its enemy long before the enemy will feel painful effects. How then can the painful effects of the poison in any way protect the caterpillar? Only, I take it, through its educating influence. Only by birds and other enemies learning through experience, in the same way as do the wood-cutters, that these creatures are dangerous to touch. Birds, without doubt, do learn in this way, and the highest authorities could be quoted to show that the whole principle of warning devices depends on the enemy's capacity to learn. A bird is not afraid of a warning colour through any instinctive fear of the warning, but just because it has learnt its lesson as a child learns to dread the fire. I think it is exactly the same in the case of these urticating caterpillars. They escape because their enemies have learnt what they are.

Thus we see a succession of processes. First comes the extraction of the hair, then the breaking of the hair into spines, then the entering of the spines into the skin, then the liberation of some subtle poison followed by an inflamed patch. The fingers are then brought to the infected spot. Some spines stick to them. The spines are carried by the fingers to other parts of the body. New foci of inflammation are started. These again are scratched. More and more foci are formed in the same way until in the end the whole body is involved. Thus we see in what a simple mechanical manner can the poison of a small caterpillar produce such a widespread effect.

The possession of poison-hairs is fairly widespread amongst caterpillars. For some strange reason, it seems to be confined to the caterpillars of moths. At least, I know of no butterfly larva armed in this elaborate way. The LYMANTRIIDÆ, LASIOCAMPIDÆ, EUPTEROTIDÆ, LIMACODIDÆ, ARCTIIDÆ, are the chief families of Indian moths whose caterpillars have evolved the poison hair.

PURPOSE OF THE SIMPLE HAIR

We have seen the purpose of the poison hair. But this is a highly specialized contrivance. What about that far more common structure, the plain, simple, ordinary hair in which such myriads of caterpillars are clothed? What is its function? Why should such a crowd of caterpillars go in for the silky dress?

Different suggestions have been put forward. I shall mention them only briefly, and leave to the end the personal views which I have come to from observation in the field.

1. *Use as a breakfall.*—This suggestion I believe to be quite fantastic. It is that the caterpillar's hairy coat saves it from injury should it happen to fall. The coat of hairs projecting from it makes a kind of springy garment which lessens the shock when it strikes the earth. Certainly hairy caterpillars do fall to ground. Many kinds, when alarmed, roll themselves into a coil and allow themselves to drop from a twig or leaf. But they cannot need this specialized buffer, for think of the numbers of naked caterpillars which habitually drop to earth and never come to any harm. It is not a bump that a caterpillar fears, but a stab from the ovipositor of a parasite or a pinch in the beak of a bird.

2. *Use as a slip-away device.*—A number of hairy caterpillars, when alarmed, roll themselves up into close-wound coils. This attitude is said to protect them by preventing birds from getting a grip. A caterpillar, for instance, of the Great Tiger Moth, when rolled up, is not easy to take hold of. The covering of hairs makes it slip through the fingers, and it may be that for the same reason it will slip from the beak of a bird. In that fine old work of Kirby and Spence we are told that the larva of *Anthrenus musorum*, a destructive beetle that gets into cabinets, is covered with numbers of diverging hairs which cause it to glide from between the fingers as if it were lubricated with oil.

Thus it may be in some special instances, though I have little faith in the idea, that the hairs may function as a slip-away device.

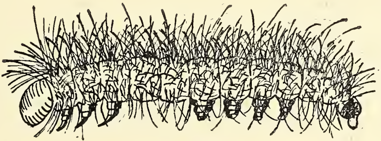


FIG. 2. Caterpillar clothed all over in simple hairs.
Use.—*a.* Distastefulness to lizards and birds.
b. Defence against ants.
c. Defence against parasites.

3. *Use by being distasteful to birds (Fig. 2).*—This view brings us to surer ground. It is a fairly well-established fact that birds and lizards do not like hairy caterpillars. The hairs, no doubt, are mechanically unpleasant to them. Also it is obvious to common observation that many kinds of hairy caterpillars travel quite fearlessly in the open, careless of any attack from birds. Nevertheless it is well known that cuckoos will eat quantities of hairy caterpillars. They seem to have some capacity for dealing with the problem which is not possessed by other kinds of birds. The little point would be worth investigation. Does the cuckoo digest the hairs, or does it vomit them forth again as birds of prey do feathers and bones?

4. *Use as a decoy* (*Fig.* 3).—Certain caterpillars have their hairs collected into tufts, conspicuous projecting brushes which immediately attract the eye. In these instances it is suggested by Professor Poulton that the tuft is a kind of decoy. A bird or lizard, making a grab at the caterpillar, will seize hold of the conspicuous tuft. The hairs, which, in such cases, are loosely attached, will come out as soon as they are grabbed. And the bird will get not a luscious caterpillar, but a mouthful of irritating hairs. The chief thing about this explanation is that it has been proved by means of experiment. Professor Poulton gave these caterpillars to a lizard in a cage. They did grab the tufts and the hairs came out. Also the lizards were discomfited and refused to repeat the attack.

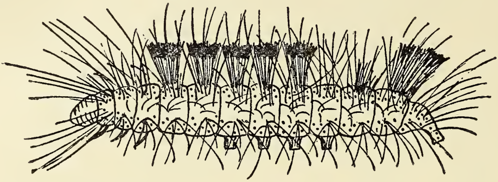


FIG. 3. Caterpillar with conspicuous loose tufts.
Use.—To decoy birds and lizards from caterpillar's body.

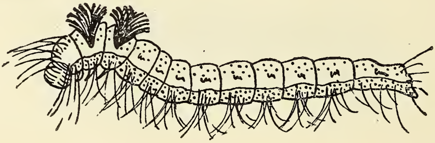


FIG. 4. Caterpillar suddenly protruding brushes.
Use.—To intimidate bird or lizard.

5. *Use as a frightening device* (*Fig.* 4).—Caterpillars belonging to the Lasiocampid family best illustrate this peculiar use. On their backs, a short distance behind the head, are two transverse slits. When the caterpillar is touched these slits open and there is suddenly thrust out from them a black brush of velvet hairs. It is an abrupt and astonishing performance. One would think that the skin had burst asunder to let out these conspicuous brushes. Their extrusion is so unexpected that one is just a little frightened at the apparition and feels that with this creature one had better not interfere. For a little while the tufts remain protruding; then they are slowly drawn back and hidden once more within the slit.

The sudden protrusion of these dorsal brushes is clearly for the purpose of causing alarm. It is a device having the same object as the assumption of a face apparition by the puss caterpillar, or the snake-like appearance by the caterpillars of some Sphingidæ; a sudden unexpected frightening manœuvre to intimidate a lizard or an insectivorous bird.

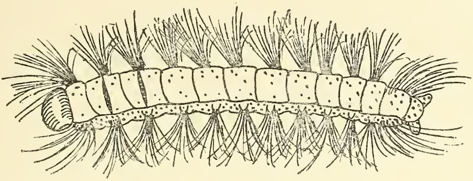


FIG. 5. Caterpillar fenced round with fringe of hairs.
Use.—To keep off ants or prowling parasites.

6. *Use as a protection against ants* (*Fig. 5.*)—Ants are amongst the most serious enemies of caterpillars, at least on the plains of India. Naked caterpillars are completely at their mercy, but the hairy ones are practially immune. Indeed we may advance the general rule that if a caterpillar happens to be naked, then it has some special protective device. It goes in for colour assimilation or alarming attitudes, or snake-like resemblance, or offensive discharges, or horn-like protuberances which it lashes about. But when the caterpillar is covered with hairs, it discards the use of these extravagances. Its hairs are protection enough.

Now see how this works with the ants. The caterpillar of *Thiacidas postica* is very suitable for investigation. It is common, clothed in long hairs, and feeds on the Ber which is frequented by black ants. These ants, *Camponotus compressus*, are particularly fond of caterpillars. They destroy hairless ones wherever they find them, but they never touch the hairy *Thiacidas.* The caterpillar has no special capacity for resistance. When disturbed, all it does is to roll into a coil and allow itself to drop to ground. Its immunity from the ants depends on its hair. I place one at the entrance to an ants' nest. But the ants will not touch it. They approach it, threaten it with wide-open jaws; obviously they would like to pitch it aside, but they fear the shield of hairs. Occasionally a worker may take hold of a hair, but the hairs happen to be only loosely attached, and all that happens is that the hair comes out. As a rule, the slightest touch of a hair is sufficient to repel an ant. One thing is perfectly clear. The garment of hairs gives complete immunity. The ants will not dare to penetrate the defence in order to get at the caterpillar's skin. In the end the caterpillar crawls away unharmed leaving behind it a tumult of ants.

An experiment will convince anyone who doubts. I pluck one of these caterpillars bare, a quite simple operation, since the hairs are loosely fixed and come out with a gentle tug. To the ants I give this stripped larva. It is as active as ever and runs about, apparently none the worse for the loss of its coat. But now it is completely at the mercy of the ants. They fall on it, grip it, seize it on all sides and drag it into the nest. Thus I feel sure that, at any rate in India, one of the chief uses of the caterpillar's hair is to guard it from the swarms of ants.

7. *Use as a defence against parasites.*—The most dangerous of all caterpillar-enemies are parasitic hymenoptera and diptera. These foes possess long spear-like ovipositors which they thrust into the body of the caterpillar. Now, in order to reach the caterpillar's body, the parasite must either enter the hairy investment or else have an ovipositor of greater length than that of the caterpillar's hair. Here is an incident one may sometimes witness. A hairy caterpillar is on a leaf. A parasite approaches and comes close up to the hairy barrier which extends all round the caterpillar's body. It then tries to get at the caterpillar. It puts its ovipositor between the hairs, then feels and pushes in different directions. trying to reach the caterpillar's skin. It will not itself enter the barrier. Like the ants, it dreads the touch of a hair. Its success depends on whether its ovipositor is long enough to reach the caterpillar's skin. If not, the parasite goes off.

This little observation from India is confirmed by something similar from Africa. Dr. Carpenter was watching some hairy caterpillars belonging to the family Eupterotidæ. He saw a Tachinid fly approach them. It sidled about them in an amusing manner, but all the time kept facing the caterpillars. Now there was only one opening in the fence of hairs. The head end of the caterpillar was comparatively bare, and the fly seemed to know this point of weakness, for it made its attack at this open spot. It elevated itself on its hind legs, pushed underneath itself an enormous ovipositor the tip of which stuck out in front of its head. By this means it managed to place an egg in the open space near the head of the caterpillar. If it could not get at the head, then it tried to push its ovipositor between the hairs. But it clearly chose the open spot because it disliked the caterpillar's coat.

These little observations, I believe, give us the main clue to the use of the caterpillar's hairy covering. It is not an uncommon arrangement for the hair to be distributed in the form of a fringe along either side of the caterpillar. Take for example the Lasiocampids (Fig. 5). In these the fringes are so thick that the caterpillar is surrounded as if by a fence. For what purpose? Because the flank attack is the most dangerous. Hymenopterous parasites dislike hairs, and, so far as I have seen, do not alight direct on the caterpillar's body. They first settle on the leaf, then creep towards the caterpillar. Hence the danger to the caterpillar is from the sides. What it particularly wants is a fringe that surrounds it like a ringed fence.

We know so little, indeed scarcely anything, of the way in which these parasites perforate their victims. For example, what parts of the caterpillar are vulnerable? What parts do the parasites habitually make for? What is the length of the parasite's ovipositor, and its relation to the length of the caterpillar's hair? These and a hundred other questions will have first to be answered before we can know the whole reason for the arrangements of caterpillar's hairs.

Certainly we have a fragment of knowledge. Here and there we have a record of a particular parasite being the enemy of a particular caterpillar. But what do we know beyond the names of the species? Where are the necessary field observations that will help us to elucidate the point in question? They are almost altogether absent. Too much care and patience is necessary for Naturalists even to dream of such a task. I believe if we had carefully detailed records of the manner in which say fifty parasites tried to penetrate fifty kinds of hairy caterpillars, the result would throw a flood of light on the multifarious designs of caterpillar structure. We should learn much that we never suspect of the uses of many of those peculiar appendages of spines, tufts, hairs, nodules, horns, tails, brushes, tussocks, and other strange superficial structures for which at present we see no use.

THE TOXICITY OF THE VENOM OF INDIAN SCORPIONS.

BY

REV. J. F. CAIUS, S.J., F.L.S.

No. 2.—*Buthus alticola*, Pocock.

I received on June 30, 1930, a specimen of *Buthus alticola* Pocock, forwarded by Captain J. W. Thomson-Glover from Malakand, North-West Frontier Province. The animal was covered with such a thick layer of mud that immediate bathing was indicated. It is during this delicate operation of washing that the scorpion stung me in the soft tissue at the base of the nail of the thumb of my right hand. I record here the action of the venom:—

12. 5. sting ; no immediate effect.
12. 10. dull pain in the first joint.
12. 14. dull pain in the second joint.
12. 52. second joint free from pain ; thumb benumbed and slightly swollen.
13. 20. 'pins and needles' in the thumb ; feeling queer.
13. 25. cold perspiration—pulse strong and normal; swelling diminishing.
13. 40. queer feeling over ; 'pins and needles' still present in the thumb.
14. 45. first joint free from pain ; area round the sting painful to the touch—the movement of the thumb free throughout.
22. 00. pain at the site of the sting ; pain disappears in the course of the night during sleep.

The animal was a male. The only other known specimen of this species, also a male, is the type described by Pocock. It is, therefore, of interest to note the characters of this second specimen which differs in some points from the original type.

Colour.—Carapace, anterior six terga, anterior end of seventh tergum, and tip of aculeus brownish black; all the other parts flavous.

Trunk.—Carapace coarsely granular and carinate, as long as the fifth caudal segment or as long as the first and half of the second ; terga coarsely granular and strongly carinate, the three keels on all the segments except the first strongly dentiform posteriorly, the granules on the sides of the terga sub-serially arranged. Sterna smooth, median crests of the fifth smooth ; lateral crests weakly granular.

Tail.—Strong, four and a half times as long as the carapace ; second segment as wide as long, fifth twice as long as wide ; median lateral keel complete on segments 1, 2 and 3, all the keels granular, superior sub-denticulate ; intervening spaces of segments weakly granular, granules on the lower surface of fifth forming two subsidiary crests; vesicle globular, as wide as high, granular below.

Chelæ.—Humerus as long as carapace ; brachium three times as long as wide, with two superior crests well developed and granular, upper crest of posterior surface also present ; hand long and wide, wider than brachium, smooth, its width about two-thirds of the length of the underhand, the latter scarcely half the length of the movable digit ; digits separated at the base, furnished with 14–15 rows of teeth.

Legs.—Granularly crested femora ; tarsi with two rows of black spinules beneath.

Pectinal teeth 25.

Measurements.—Total length 78 mm. ; carapace 10 ; tail 45·5 ; brachium 10 ; underhand 5 ; movable finger 12 ; width of hand 4·8, of brachium 3·5, of first caudal segment 8, of fourth 4·5.

Locality.—Malakand, North-West Frontier Province.

Remark.—The animal lived peacefully for over a month in the company of a dozen *B. tamulus* ; but it refused to eat their fare of cockroaches and bluebottles.

REVIEWS.

1. SYSTEMA AVIUM ÆTHIOPICARUM. Part II. By W. L. Sclater, M.A., M.B.O.U. pp. 305-922, 1930. Taylor and Francis, London.

We gave a short notice of the first part of this volume in a previous number of the Journal (Vol. xxx, p. 447) and we are now glad to have the opportunity of drawing attention to the completion of this great work.

Mr. Sclater in his introduction has given an interesting comparison in regard to the numbers of birds dealt with. The 'numbers of sub-species and species not divided into sub-specis' dealt with by him are 4,439, whereas those given by Mr.Baker in the second edition of the Fauna are 2,293 and by Dr. Hartert in 'Die Vögel der paläarktischen fauna' is 3,198, while the late Mr. Chubb enumerated 4,561 names in his list of the birds of South America, which however has been considerably added to since.

A systematic list of the birds of the Ethiopian region may not at first sight appear to concern the members of our society, but since the area dealt with includes Arabia, south of the Tropic of Cancer, it should be of some interest to anyone stationed at Aden or Muscat. Furthermore, many migrants which come to India during the cold weather are also found in Africa in the winter. Then too there are a number of birds which are common to both India and the Ethiopian region, such as the Pied Crested Cuckoo, *Clamator jacobinus jacobinus* and the Indian Swift, *Micropus affinis affinis*. In addition, a number of Indian species are replaced by closely allied races in Africa. That interesting bird, the Spotted Creeper, *Salpornis spilonota spilonota*, which is found from Behar and Orissa to Khandesh, is represented by three or four races occurring right across Africa to Angola, while our familiar Rose-ringed Parroquet, *Psittacula krameri krameri*, is replaced by sub-species, very slightly differentiated in Abyssinia and West Africa.

Introduced species, which have become established, are included in the list, and it is interesting to note that quite a number of Indian birds occur in different parts of Africa. The Common Mynah is found in Madagascar, Mauritius, Natal and elsewhere, the Indian Grackle in St. Helena, the House-Crow at Zanzibar, Muscat and perhaps Aden, besides several others. On the other hand, no African bird which has been introduced into India has succeeded in keeping a footing in a wild state.

African Ornithology owes much to India. In the days of 'John Company' the Bombay Government had representatives at Zanzibar and Aden and Sir John Kirk was appointed surgeon to the Political Agency at the former place in 1865 and finally in 1880 became Political Agent. He had already made a collection of birds when accompanying Livingstone on his exploration of the Zambesi region in 1858–64 and later sent native collectors to obtain birds in various parts of East Africa.

In December 1840 Sir William Harris, of the Bombay Engineers, best known as a big game hunter, was sent in charge of a mission to Shoa and made a considerable collection of birds which was deposited in the Company's Museum in London. Six years later, Capt. Speke of the 46th Bengal Infantry, the discoverer of the source of the Nile, accompanied Lt. (afterwads Sir Richard) Burton on an expedition in Somaliland and brought back several new birds, which were described by Edward Blyth of the Asiatic Society's Museum. Some years afterwards Burton, who was in the 18th Bombay Native Infantry, was appointed Consul for West Africa and from time to time sent a number of interesting birds to the British Museum from the different localities he visited.

Dr. W. T. Blanford, in his time the foremost naturalist in India, accompanied the Abyssinian Expedition of 1867 as Geologist and collected birds while a well-known member of the Society, Lt. H. E. Barnes published in the *Ibis* for 1893 an article on the Birds of Aden. On the Persian Gulf side of Arabia, Col. Miles, Dr. Jayakar and Sir Percy Cox have contributed much to our knowledge of the avifauna of Muscat, which however is just north of the tropics.

In 1899, Dr. Donaldson Smith made an expedition to northern Somaliland, on behalf of the Gaekwar, for the purpose of collecting birds for the Baroda Museum and a report on his collection is given in the Proceedings of the Zoological Society for 1901.

Then perhaps we may include the great collections made by Sir Harry Johnston in Nyassaland, since they were collected for him by Alexander Whyte, formerly a chemist in Ceylon, nor must we forget that the author of the 'Systema' was himself for some time in charge of the vertebrates of the Indian Museum, Calcutta.

To any one studying African birds, this work is indispensable and to Museum curators it should prove very useful, for in addition to the correct scientific name, there is a short summary of the distribution of each species, and last but not least, every bird is denoted by an English name.

N. B. K.

2. HANDBOOK OF THE BIRDS OF WEST AFRICA.—By G. L. Bates, London, John Bale Sons & Danielson Ltd., pp. i–xxiii, 1–572.

A book on the birds of West Africa has long been wanted and except for the two small volumes by Swainson in Jardine's Naturalist's Library, no work has been written on that region.

The area dealt with may be said to be roughly that south and west of a line drawn from the northern border of Sierra Leone to Lake Chad and from there southwards to the southern frontier of French Cameron. It consists of three types of country: (1) the forest, principally near the coast, then (2) savannah and (3) the semi-arid or thorny belt abounding on the desert area to the north.

The avifauna varies with each type of country, but some resident species are common to all three, while in addition, there is the migratory population of winter visitors from the north—birds such as the stork, wryneck, many waders, ducks and warblers. The marine species are not included which we think is rather a mistake.

Mr. Bates, the author, was for a long time resident in the southern portion, in what was formerly German Cameroon, and contributed numerous articles on the birds of that region to the *Ibis*. He has also made several expeditions to lake Chad, the upper Veeta and elsewhere and is therefore well fitted for his task.

There is a description of each species both in adult and, when known, in juvenile plumage, with measurements and other data followed by a paragraph in larger print giving distribution and brief notes on habits, but no mention is made of the range outside the area. This we think should always be included even though very briefly. There are keys to the families genera and species which should prove helpful.

This is a very useful handbook and from its small size and compactness, can always be carried even though the traveller has restricted his baggage to a minimum.

N. B. K.

3. BOSE, SIR J. C., THE MOTOR MECHANISM OF PLANTS.—Longmans, London. 1928. Pp. xxv, 429. 21sh. Net.

In this book the author continues his studies on the physiological processes of plants. It follows, as a matter of course, his preceding work. 'The Nervous Mechanism of Plants' in which the author gave the results of his investigations on the conduction of stimuli, and established the fact, subsequently confirmed by others, that plants—at any rate vascular plants—possess a well-defined nervous system.

Here the author has brought together in a connected form his researches, spreading over many years, on the nature and mechanism of movements of plants. An account of his most recent investigations, rendered possible only by the invention of very ingeniously contrived and highly sensitive instruments, is also given. These studies, which are concerned not only with *visible external* movements but also with the *invisible internal* movements, have enabled Sir J. C. Bose to state that in plants 'the motile organ has reached a high degree of complexity hitherto unsuspected, containing as it does, contractile tissue which may be well called 'muscle' and conducting tissue which may well be called 'nerve'. Further he comes to the conclusion that the contractile tissue closely resembles animal muscles in its properties.

The studies are divided into two sections. The earlier chapters are devoted to the investigation of movements induced only by external factors, such as Heat and Light; and chemical, mechanical and electrical stimuli. The latter part of the book is concerned with the investigation of what are known as autonomous movements, since they are not *apparently* induced by any external stimulation. The author, however, shows by a series of ingeniously devised experiments that there is in reality no fundamental distinction between the two. According to him, one is the result of the depletion of energy under unfavourable conditions, and the other, of the absorption of energy from without under favourable conditions. Put in his own words 'Biophytum is thus equivalent to a Desmodium brought to a state of standstill by depletion of its store of energy and Desmodium to a Biophytum with an excess of stored energy.

Owing to their exceptional sensitivity, it has generally been tacitly assumed that contractility and irritability are only exhibited by the so-called 'sensitive plants' and that the other plants are neither excitable nor capable of movement. The author has specially dealt with this question and demonstrates that under suitable conditions of stimulation and investigation all plants show identical responses, the difference, as it is found, being only one of degree and not of kind. The method he adopts is to study the characteristic behaviour of the 'sensitives' under different modes of stimulation first, and afterwards, under identical conditions, to study that of the 'insensitives'. The results thus obtained are shown to be identical proving that, however latent, the power of response is shown by all plants. The greater sensitiveness of plants like Mimosa is further shown to be due to the presence in them of a larger number of contractile cells. Besides, it is also demonstrated that intermediate types occur between such sensitive plants and those that are apparently insensitive.

Particularly interesting are the investigations relating to the ascent of sap in plants. The generally-accepted explanation of this phenomenon has so far been that the rise is due to purely mechanical causes—a push from below due to root pressure and a pull from above due to transpiring leaves. The experiments detailed in the book, of which there is a variety, prove convincingly on the other hand, that the movement of sap is due to the physiological activity of a definite tissue, the cortex. It is shown that 'the leaves and roots in the intact plant evidently do not exploit the full potentiality of the propulsive mechanism', for the rate of ascent was found to have become doubled after the removal of the roots. Also, according to the findings of the author, the role of transpiration is merely to set up a turgor-tension gradient by causing incipient drought in the transpiring region and thus to facilitate *continuous* flow. The flow was found to be still maintained even when the leaves were removed, until the turgor of cells at both ends of the cut stem became the same, when it stopped.

With regard to the mechanism of propulsion, Sir J.C. Bose has found that the cells of the cortex are in a rhythmic state of pulsation, pumping the sap forward by their alternate expansion and contraction. In this rhythmicity and the function thus performed, he sees in plants the existence of a propulsive mechanism similar to that of the circulation of blood and food in animals. In this connection too, he makes the very interesting observation that the membrane of each individual cell of the cortex acts as a valve, which allows easier passage of the sap in one direction than in the other.

Throughout the book the author shows by records of crucial experiments on plants and animals, carried out side by side, that under identical conditions of stimulation, the response in the one is exactly paralleled by that in the other, whether the stimulation be caused by external agents such as pressure, temperature, etc., or by the administration of drugs. 'The throbbings of the pulsating life' in the words of the author said elsewhere, 'have been found to wax and wane under the specific action of drugs coming to an end at the death of organism.' Thereby he once more establishes the great generalization of the identity of mechanism of all life.

While the conclusions drawn by the author have not been universally accepted, every one has acknowledged and admired his great ingenuity in arranging and constructing new apparatus with striking combinations which, besides aiding in other remarkable investigations, have rendered possible the measurement of the *contraction* of a single cell!

In this book, which like its predecessors is full of important data, even those who may not agree with the views of the author, will still find much food for thought. The students of plant life particularly, and specially those of plant physiology, will find here much to stimulate their thoughts and suggest fresh problems for investigation.

N.K.T.

4. LEHRBUCH DER ALLGEMEINEN PFLANZENGEOGRAPHIE.—von P. Graebner. 2 umgearbeitete Auflage. xii, 320 pages (illustrated). Leipzig. Quelle & Meyer. 1929. 14.80 Marks.

Plant Geography, in its wider sense, is claiming increasingly greater attention from all students of Botany. This is reflected in the increasingly greater output of works, both in the form of original papers as well as of books, which is being published from time to time. To this growing literature the present work is a useful addition. It makes, however, a very agreeable departure from the beaten track followed by most of the published treatises on this subject so far. These latter have in the main—if indeed not exclusively—devoted their attention either only to the floristic side or to the ecological aspect. Even then hardly any of them have attempted to draw upon the large resources of other branches, such as Palæobotany, General Biology, etc. The result has been a very lop-sided presentation, lacking co-ordination and perspective, and generally devoid of that stimulating feature which can only be imparted by its fuller treatment as a part of, and standing in close relation to, the other branches of Botany.

The present book avoids this general but faulty practice. It combines in itself the useful features of the usual method of treatment with a clear indication of the correlation that the described facts have to the other branches. In this way emerges a complete picture of the organic whole, and the result is a pleasing and readable book.

The text is divided into three sections. Preceding these is a short introduction. This gives an historical sketch of the development of Plant-Geography. Then follows a general account of the development of the Plant World through the geological times, interpreted with the help of palæobotanical records, and this is continued into an account of the development of the existing types of vegetation. The author shows clearly in a limited space how, starting from small beginnings in the far-off geological ages, almost in a monotonous uniformity, the vegetation has continued to vary in form and distribution in response to the operation of external factors, the most potent of which, according to the author, has been the climate. In this section the author has pressed into service the results of researches into all phases of Botany. During the course of the treatment he refers to, and attempts to explain many interesting biological facts connected with the evolution and distribution of plants. Such, for example, are the evolutionary sequence of the somatic and reproductive organizations, biological interpretation of variations, origin of species, inheritance of acquired characters, origin of angiospermae and of the hermaphrodite flower, etc., etc. Besides these are also treated changes of climate and relative areas of land and water during geological ages, and the facts and causes connected with the geographical distribution of plants,

The second and the third sections are devoted, respectively, to the floristic and the ecological plant geography. The former treats of the usual topics of the floral regions and the floral provinces, the chief vegetational and climatic features of which are briefly set forth. In the latter the author first deals with the various classes of factors now operating to transform the existing vegetation, viz., the climatic, the edaphic and the biotic. The treatment of the last is very meagre and fails to convey a just appreciation of the influence of these on the changes induced on vegetation. The activities of the animals, and chiefly of man, are treated under the ' miscellaneous ' factors and disposed of in a few paragraphs. Finally there is an account of the various terrestrial and aquatic ' formations '.

There are numerous clear drawings and photographs, though some more such as those depicting the characteristic desert landscapes and aquatic associations could, with advantage, have been included. There is a copious citation of literature in the form of footnotes. There, however, appears to be no mention of Willis's work. Elodea is throughout referred to by its less commonly known name of Helodea.

The basic idea in the preparation of the book, says the author in the preface, has been not to make the all-embracing subject of plant-geography appear as a confused mass of memory lumber and of otherwise dry details, but to relate the existing plants to their previous history and to the forces now in operation, so that the whole may appear as a sound system. In this the author has amply succeeded, and one may express with him the hope that the book may gain friends and may succeed in bringing back those who through dry and one-sided treatment, have become alienated from this interesting and absorbing subject!

N.K.T.

5. PLANT STUDIES.—By T. Ekambaram, M.A., Ph.D., pp. x + 157 (illustrated) Longmans, Green & Co., Ltd., Calcutta, 1929.

This little book from the pen of the author who has been connected for some time with a Teachers' Training College, has been written to help teachers of Plant Life in lower forms of the schools.

The subject matter, consisting of the descriptions of over a score of common plants, has been presented in simple language, and one notes with real relief and satisfaction the absence of that laborious and dry style, consisting in the introduction of a frightful array of technical words, which is so common a feature, but nevertheless a very serious drawback, of the majority of the published text-books.

In describing the plants, the author has not restricted himself merely to the narration of dry-as-dust facts, but has woven them up into a complete story of the plant, correlating structure with function, and indicating the purposes which the various organs of the plant serve in the economy of life, as well as the manner in which they are adapted to the conditions of their surroundings. This mode of treatment appears to be the only sound and satisfactory way of introducing the readers, and specially the beginners, to the study of plant-life, but while almost all the text-books on Zoology have been following this commendable practice since long, there is no indication yet that the writers of botanical books have realized its necessity and usefulness.

In the matter of the choice of plants, while the opinions of the individuals will continue to differ, it may be said that the author has bestowed sufficient care and thought in selecting a representative variety of types to convey a fairly complete idea of the plant world. Naturally most of the types are drawn from the dominant class of Angiosperms, but an attempt has also been made to include representatives of other classes as well.

The book is fairly well illustrated and is free from errors. On page 9, however, calyx is wrongly defined as consisting of sepals 'when they are united to each other, and form a sheath or a tube or a cup.' This should be corrected in future editions. The statement on page 97 regarding the movements of the 'flower' of the Sun-flower along with the motion of the sun is not in accordance with facts and requires to be corrected.

N.K.T.

6. ZOOLOGY.—A Book for Indian Students by Rev. I Pfleiderer, pp. viii. + 237 (illustrated) Basel Mission Press and Book Depot, Mangalore.

The author of this book on the study of animal life is already well known as the writer of *Glimpses into the Life of Indian Plants*. What the latter book did for the students of plant-life, the present one attempts to do for those of Zoology. It is, however, more a nature study book than a book on Zoology, as this term is generally understood these days. Consequently the descriptions are free from the technical terms which so often terrify a beginner without materially adding to his real knowledge.

The subject matter surveys the whole animal kingdom beginning with the Vertebrates and ending with the Protozoa. The whole is split up into seven divisions which are further sub-divided into classes and orders. In dealing with his subject the author first gives the general characters of the divisions and classes and thereafter illustrates the characters of the orders by dealing in detail with a common type from each. Here is combined with the structural descriptions a plain description of the functions. The account is concluded with a brief reference to some other representatives of the order.

The book is very profusely illustrated and the three coloured plates add to the beauty and usefulness of the descriptions. A very vivid pictorial impression of the animal kingdom is thus left on the mind of the reader. One, however, misses the fullness of descriptions and the masterly treatment which characterized the author's book on plants. But this does not detract seriously from the usefulness of the book which is sure to benefit any one who may turn to its pages for information.

N.K.T.

7. GENERAL BOTANY.—An Introductory Text for Colleges and advanced classes in Secondary Schools, by E. N. Transeau, pp. x + 560 (illustrated). The World Book Company, New York.

The present work by an experienced teacher is a happy departure from the stereotyped plan adopted by most writers of treatises on Botany. It combines in a pleasing, instructive and useful manner, the general principles of the science with their application to many problems as they affect the daily life of man.

Besides drawing fully upon his 'rather extended experience' the author has been guided in preparing the text by information from four other sources. These are (1) the traditional course in general botany which embodies the facts and principles agreed upon as most essential by most botanists for a foundation in the subject, (2) suggestions from those who apply in a practical manner the findings of the science, namely, persons engaged in the teaching or practice of horticulture, agriculture and forestry, (3) suggestions and criticisms from the students and enquiries made by those who took advantage of the given course and (4) enquiries of a very practical nature made by the public.

From the above it will be clear that the author's desire has been to teach botany to his students with the broadest possible outlook on practical life. This is further reflected in the way in which he has handled the material and presented the facts. For instance, at the very outset, in order to draw the pointed attention to the fundamental importance of the knowledge and study concerning plant life he makes mention of the numerous ways in which man is entirely dependant on plants. This gives, from the very beginning, a new orientation to the study and undoubtedly serves to put the beginner in a mental attitude which should ensure an intelligent study, as opposed to mere cramming, of details which very often is what unfortunately 'traditional course' tends to produce. Similarly there are other chapters, in which the author while presenting the general facts brings home the great economic bearing that many of the facts so dealt with and the problems raised, have in nature.

In addition to these special features, the book, of course, treats of the general details of morphology, physiology, ecology, plant distribution, genetics and systematics in the usual way. In this treatment while all the groups of plants are included, the largest portion of the book, comprising nearly four-fifths, is devoted to the flowering plants. The Cryptogams and the Gymnosperms are treated very briefly, though such topics as 'the bacteria in relation to life' and 'the Nitrogen cycle'; 'Fungi' and 'Plant diseases', receive fuller treatment.

The treatment is lucid and simple, and a very commendable feature is the large number of illustrations consisting of many original photographs, drawings and diagrams. Many of the latter are of unusual conception and serve to illustrate the facts otwherise difficult of elucidation. At the end of many chapters useful exercises are appended. In several respects, however, the treatment is very inadequate, and this is particularly so with regard to the account of the cellular structure. The book however helps its readers to obtain a much wider knowledge, and to appreciate the facts of botany in a truer and better perspective than is possible with most of the text-books so far written on this science.

N.K.T.

MISCELLANEOUS NOTES

I.—THREE TIGERS AT A KILL

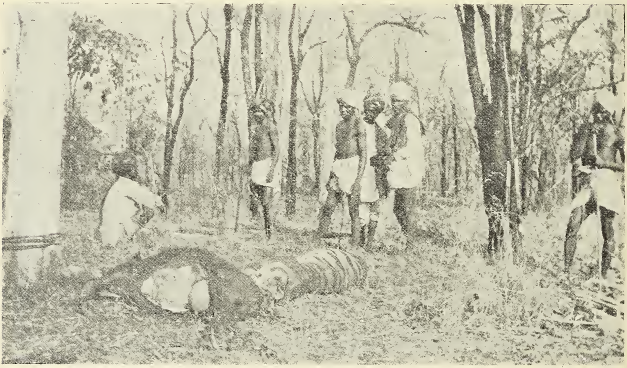
(*With a photo*)

The following account of my first day's shooting in this country may be of interest to some of your readers :—

I had been in the Nirmal district of Hyderabad some three days when a buffalo, which had been put out, was killed by a tiger.

Most of this animal had been eaten and so I sat up the next night over a fresh buffalo some 50 yards away from the old kill.

About 9–30 p. m. I heard tigers on the old kill and realized that there were more than one there.



For an hour they continued to eat and then went away and drank at a waterhole some 200 yards away and it seemed that they had gone for good without spotting my buffalo.

Suddenly there was a rush under the machan, one grunt from the buffalo and the animal was killed. I switched on the torch and killed the slayer, a tigress, which lay dead alongside the buffalo.

For several minutes I kept on the torch, to make sure she was dead.

Satisfied that this was the case, I partook of some light refreshment and was just going to light a pipe when I heard two tigers on the old kill, neither the shot nor the light of the torch had frightened them away.

Soon afterwards one of them came, and sitting alongside the dead tigress commenced to feed.

I fired and heard a rush, but could not see where the animal had gone, until I saw a tiger (which I imagined was the one just shot at) crawling through some undergrowth.

Again I fired and after some time saw a tiger lying dead some 50 yards away.

When I came down from the machan in the morning, I was surprised to find that the tiger lying 50 yards away had been shot through the heart.

Soon afterwards, the boys called me and to my surprise there was a third tigress, dead, close to the machan.

When I fired at the second tiger, this animal was still eating the old kill ; it must have come at once at the shot to see what was happening, and was killed with the third shot.

EQUITATION SCHOOL,
SAUGOR, C.P.
May 14, 1930.

C. SWIRE,
Major,
THE ROYALS.

[The writer's good fortune is excelled by a Malay who slew a brace of tigers with one shot from an old muzzle loader. The incident is related by Mr. A. L. Butler, F.Z.S. (*Journ. Bom. Nat. Hist. Soc.*, vol. xii, p. 228). The victims were a tiger and a tigress who were feeding on the carcase of a dead sambhar. It is not unlikely that the tigers observed by Major Swire were members of a family party.—EDS.]

II.—PANTHER CLIMBING UP TO A MACHAN

With reference to Lt.-Col. R. W. Burton's Note on a 'Panther climbing up to a machan:' in your Journal, vol. xxxiii, No. 4, a very similar case occurred in connection with Major F. S. Gillespie, R.A.M.C., sometime back. Major Gillespie was sitting up over a Panther kill, and heard the panther arrive (from behind) and then felt the tree gently quiver: and a moment later found the panther sitting on a branch level with him. In this instance I believe I am right in saying that Major Gillespie was so taken aback that he missed the panther badly !

HONNAMETTI ESTATE,
ATTIKAN P.O.,
via MYSORE,
April 30, 1930.

R. C. MORRIS.

[Mr. T.R.D. Bell (*Journ. B.N.H.S.*, vol. xv, p. 344), describes an exciting experience with a panther which climbed to within 10 ft. of his machan—a real instance of the hunter hunted. The machan was built 20 ft. high in a mohwa tree, some 20 yards from the kill. Close by was a second mohwa tree with a drooping branch which almost touched the ground. The panther after a preliminary survey of the machan disappeared. It was next seen at the base of the second mohwa tree standing quite still, staring fixedly at the machan. Then very quickly it crouched almost to the ground. It commenced to move forward slowly, stealthily, away from the machan towards the drooping branch, looking back now and then over its shoulder, never altering its crouching attitude. It reached the branch, glided up on to it and was lost in the screen of leaves. Presently the head appeared round the trunk. It had climbed to the level of the machan. A short leap of 10 ft. remained. A shot through the neck put an end to the stalk. Mr. Bell concludes that this panther very likely had some experience of a man on a platform in a tree. Villagers in the neighbourhood, watching their fields by night, sleep on platforms in trees. The panther had probably taken a man out of one and eaten him. It tried to repeat the experiment. This explains the boldness and the deliberateness of its stalk.—Eds.]

III.—A PANTHER INCIDENT

The following incidents may be of interest to you :—

On April 29, 1930, I sat up for a panther over a natural kill of a buffalo calf. I forgot to tether the kill, and got into the machan at about 4 p.m. At 7–30 p.m. I heard a scrape and saw the panther disappearing with the kill into thick jungle.

I could not risk a shot, since the shikari was lying up somewhere near and I did not know where he was, or whether he was in a tree or not. After dragging the kill away, in about one minute's time, the panther returned to the spot where the kill had previously been, and started sniffing at the ground. It was shot this time.

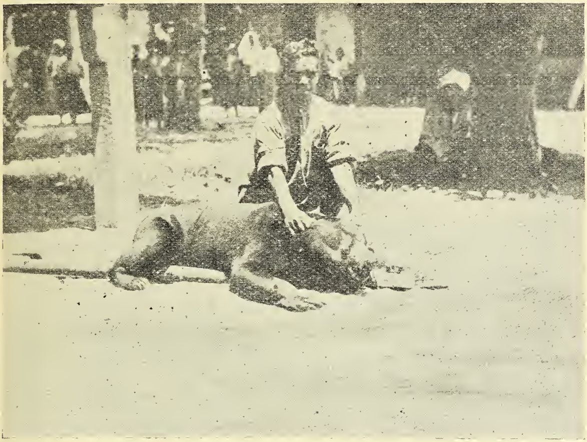
I subsequently discovered that the kill had been dragged twenty yards. Why the panther returned I do not know, for it had removed the entire carcase, and there was not a fragment left beneath the machan.

Army School of Education, G. de L'ISLE STURM.
Belgaum,
May 15, 1930.

IV.—NOTE ON THE MALAY BEAR (*URSUS MALAYANUS*).

(*With a photo.*)

I enclose a photo of a Malay bear (mature male) shot by me in July 1914 about 20 miles north of Bhamo (Upper Burma). My shikar diary unfortunately gives no exact measurements but states that he was about 4′ 6″ long ; head very broad ; short thick glossy fur with a fine orange V. He was full of honey which ran out of his mouth on the way back to the bungalow ; the Burmans had no hesitation in eating it. The above may be of interest as I do not remember seeing a photo of this bear in the *Journal* or in any shikar book. Its occurrence so far north may also be worth recording.



E. G. PHYTHIAN-ADAMS,
Major I.A. (*Retd.*).

WALMER,
LOVEDALE, NILGIRIS,
June 15, 1930.

(The distribution of the Malay Bear is given as extending from the Islands of Java, Sumatra and Borneo into the Malay Peninsula and so on through Burma and Pegu to the Tenasserim Province. Nothing definite is known as regards the westerly limits of its range, though it is said to occur in Chittagong and the Garo Hills and to be found as far west as Darjeeling. Skins and skulls of bears shot in Burma are a great desideratum. Little is known of the habits of the Malay Bear in the wild state. The 30 odd volumes of our *Journal* contain no notes on this species. Forest officers in Burma and members resident in areas where this bear occurs may be able to help in supplying the deficiency.—EDS.)

V.—SOUNDS MADE BY PORCUPINES

Unless there are far more porcupines in these parts than in the jungles Col. Burton has sat up in, it is curious that he has only recently heard the 'puffing' noise porcupines make as they wander round in search of their meals at night. I have hardly ever sat up at night without hearing and, in moonlight, seeing them. Recently I was sitting up over a kill and heard what I took to be porcupines 'puffing' along the path up to the kill, when to my surprise two bears appeared on the scene. They did not like the look of things however and made themselves scarce without delay. A day or two later I was sitting up again and heard the same noise approaching, and decided it was a bear, or bears, and two porcupines appeared! The panther was then actually at the kill as the porcupines entered the Nulla, and there followed much rattling of quills, louder puffing, and scuttling off as the porcupines discovered his obnoxious presence.

HONNAMETTI ESTATE, R. C. MORRIS
ATTIKAN P. O. *via* MYSORE,
April 30, 1930.

VI.—OBSERVATIONS ON THE INDIAN ELEPHANT

SOLITARY ELEPHANTS

Sanderson in his '*Thirteen Years Among Wild Beasts of India*', an excellent book though it is, makes several mistakes. In regard to elephants he commits two errors which are remarkable in view of the fact that Mr. Sanderson's knowledge about elephants, and his experience in the capture and shikar of Indian elephants has, I suppose, been unequalled. He states in his book that 'a really solitary elephant is rarely to be met with.' I am certain this is not the case. My experience is that solitary elephants seldom rejoin herds. A solitary tusker will certainly graze with any herd that may happen to be in the same jungle for the time being; but will generally stay behind when the herd moves on to new grazing grounds. I believe that when it becomes '*musth*', a solitary elephant will seek a herd, but directly this sexual state in the elephant has passed off, it will return to its solitary life. The elephants on the Baragurs in North Coimbatore are certainly nearly all solitaries, and I do not suppose that there are ever more than three small herds for the whole length and breadth of that range. A single tusker (rogue) which I shot in March 1928 on the Billigirirangans had been known to be in the same jungle for at least 20 years, leading a solitary existence. I saw him there myself in 1913 or 1914 and when I shot him in 1928, he was approximately in the same place! Solitary elephants are in my opinion not the leaders of nearby herds as supposed by Sanderson. I agree with Sanderson that it is highly improbable that any male elephant is driven from its herd, and I have always expressed this view in regard to both Bison and Elephants. I feel sure that in both cases the bull arrives at an age when it prefers to live a solitary life.

SIZE OF ELEPHANTS

Again Sanderson states 'there is little doubt that there is not an elephant of 10′ at the shoulder.' It is extraordinary that Sanderson should have made such an assertion. The two tallest elephants I have ever seen were two single tuskers, shot by Major Brook Purdon

R. A. M. C., in 1925, and by me in 1928. In each case, the elephant had only one tusk and both were 10′ at the shoulder; in fact the first was just over 10′.

SPEED OF ELEPHANTS

Sanderson's estimate that an elephant can run at a fast shuffle at about 15 miles an hour is no exaggeration, and was supported recently by writers (mostly referring to African Elephants) in the *Field*. Personally I consider from my own experience that an Indian Elephant when 'all out' can travel quite 20 miles an hour. I do not think any 'mahout' can make an elephant travel as fast as one in full charge, or in full terrified flight. I once saw a pair of elephants cross a grassy flat, and their speed over this stretch of about 300 yards must have been nearly as good as that of a race-horse.

R. C. MORRIS.

HONNAMETTI ESTATE,
ATTIKAN P. O., *via* MYSORE,
June 10, 1930.

VII.—ON DISTINGUISHING BETWEEN MALES AND FEMALES AND OTHER CONTROVERSIAL MATTERS PERTAINING TO THE GAUR (*BIBOS GAURUS*)

A writer in a sporting journal recently wrote that a bison (gaur) has no dewlap. He was quite rightly contradicted by another correspondent who stated that bison do possess dewlaps. Most sportsmen who have had any experience with gaur will agree that the dewlap in a bison varies greatly, ranging from a large one to none at all.

It is curious to read the varied dicta expressed by authors on matters such as these and laid down by them as facts. Take for instance the subject of the colour of the gaur's eyes which have been described incorrectly by many well-known sportsmen and naturalists, including the late Mr. G. P. Sanderson. The description of the gaur's eyes as given by most authors applies to the colour of the eyes after death and not in the live animal.

To turn back to the subject of bison, and the views expressed on them by various authors, I think that J. W. Best in his '*Indian Shikar Notes*' makes a great mistake when he says '. . . . the cows are very difficult to distinguish from bulls; in some cases, however, the cows are lighter and even dun-coloured, and their horns are smaller and curved more inwards than those of the bulls. These are, however, no sure guides, and, unless absolutely certain that he is aiming at the bull, a sportsman has no business to press trigger.' This book was, I think, originally written for novices and, as such, I consider that a greater error could not be made than to say that a bison cow is difficult to distinguish from the bull. I think this is an extraordinary statement to make for a *shootable* bull bison is as different from a cow as a fine stag sambhur is from a small brocket, and a young sportsman should be told that unless he sees such a bison, of a bigger build, darker colour, and heavier in horn, than nearly every other member of the herd, he should not shoot. I add in the word '*nearly*' as it is quite possible for two shootable bulls to be in a large herd. I should say that in *all cases* cows are lighter than a good bull, and a cow's horns are certainly smaller in *every* case than those of a shootable bull ; nor is the dorsal ridge in a cow nearly so well formed.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
via MYSORE,
June 10, 1930.

R. C. MORRIS.

[The presence or absence of a dewlap in the gaur is a character which varies with individuals. All stages of development may be observed. It is very pronounced in some animals and scarcely noticeable in others. The colouring of the gaur's eye has again been the subject of a controversy—some maintain the eye is blue and others that it is brown. The fact is that the eye is blue in certain lights and brown in others. Everything depends on the angle of ohservation. In his note on the colouration of the gaur's eye (*Journal*, *Bom. Nat. Hist. Soc.*, vol. xxxi, p. 220), Mr. Dunbar Brander explains that the blue colouration which the eye exhibits in certain lights is due to the fact that the basal portion of the choroid membrane behind the eye is blue. The blue showing through the transparent cornea may give, at certain angles, the impression that the whole eye is blue. The iris, the conjunctiva and the greater part of the choroid membrane is however brown, so that in certain lights again the eye appears to be brown.—EDS.]

VIII.—VIGILS AT WATERHOLES

On Jan. 6, 1929, at camp Ghartal, six miles from the railway station of Warghoda in the Central Provinces, my shikari brought in the news that he had seen the fresh pug of a tiger at a waterhole in the dried-up bed of a stream about half a mile from camp, and so I decided to sit up over this in the evening.

On reaching the spot indicated I found that there were two waterholes about 80 yds. apart, and besides the tiger spoor, also those of sambhur, pig, and peafowl, so I concluded that this was the drinking ground for very near all the game in the vicinity.

I took up a central position amongst some scrub under a stunted tree at 4 p. m. and patiently awaited developments. The first denizen of the jungle to arrive was a pig who nosed about in the slush and then walked away down the river-bed towards the cotton fields. After this I suddenly beheld two quivering ears and a Sambhur stag with his hind and fawn came in to the scene. The stag after drinking walked through the pool and then indulged in a wet mud bath. He did not appear to take any interest in his mate and young. The fawn running up and down through the water, was having quite a happy time; but not so the mother. She was absolutely alert to every sound and movement, and was in a great 'state of nerves.' She never even put her nose to the water, and appeared specially disturbed to think that her fawn was making such a noise and attracting attention. The stag, after his mud bath got up, rubbed himself against a tree by way of finishing his toilet, and then walked off, while the hind and fawn walked back the same side from whence they had come, and one was led to believe that they had just walked down so far to see the old man off on his nightly wandering.

After this nothing happened for about half an hour, and then a hare came hopping along, every now and then raising himself on his hind quarters and surveying the country all round. As it had by now turned quite dark, I had come out of the bush and the hare came up to within a foot of me, looked me up and down, made his diagnosis and then hopped off up the bank.

On another evening a fawn came down for a drink and was suddenly surrounded by a pack of wild dogs, five in number. They would surely have killed this fawn as it was alone and very frightened. I however fired and killed one of them and this scared the rest away. I am sorry I was not able to kill a few more of these vermin.

On yet another occasion I was standing over another waterhole at dawn, hidden in a bush, when I heard a rustling in the grass behind me and, on turning round, beheld no less than four chinkara deer coming for a drink. My movements however disturbed them and away they went like a flash to be followed, a few minutes after, by a peahen and four chicks, two of whom had a three round contest, after a sip, much to the consternation of the old hen. Then came a troop of monkeys but there was no gainsaying why they had come. They were very matter of fact, very determined, and it was a case of, 'well this a waterhole, we are thirsty, we have come for a drink, so let's have a drink and be done with it, why make any bones about the matter.' And then just when I thought that it was now too bright for anything else to come, a wretched, loathsome hyæna appeared. He sliddered up sideways. I shot the skulking brute.

But it is not always that one has such a passive time when keeping watch over a waterhole. On Dec. 8, 1928, after sitting over a goat for three evenings waiting for a leopard, I was advised by the shikari to try a drinking pool. This was about $\frac{1}{4}$ of a mile from the cave in which he dwelt. I therefore took up my position on a little hillock overlooking the water and about 30 yds. from it. Just as dusk began to fall, a chinkara came for a drink. The next thing I remember seeing, was a yellow and brown object fly pass, pounce upon the gazelle, and virtually bound into a bush with it. The suddenness of the attack was really starting. No tigers were reported in this locality, nor had any pugs been seen, and finally this was not what one could call tiger country.

The skin made a very acceptable birthday gift for my wife, for needless to remark a ·423 mauser bullet soon found its billet in the neck of this 8 feet 4 inch specimen of fury. It is also interesting to note that the way in which this tiger grabbed and bounded off with his prey is not what is by any means the usual procedure, possibly the open space and scanty stunted scrub accounted for this.

On Jan. 9, 1929, I was out at very early dawn on a path where the previous evening I had seen the fresh pug of a leopard. This was about ¾ of a mile away from my camp. I was standing behind a tuft of grass and directly in front of me was a shallow nullah with stunted trees and wild plum bushes around a waterhole. The stillness was suddenly interrupted by the early morning prayer of the *Bhimraj* (King crow) as he called out ' thakur jee ', and then I heard a stealthy movement and perceived a black object nosing about near the plum bushes. The object looked big and in the uncertain light, the movements were not unlike those of a bear, many of which were reported around. I raised my rifle twice to fire, but could not see the foresight. As however the object was ignorant of my presence and was feeding quite happily, I thought a little patience was called for on my part. A few seconds later, when my quarry was broadside on, I chanced it and fired. Then followed a jump into the air and a thud. I metaphorically shook hands with myself only to feel very downcast a few seconds later when my gun boy who had run up shouted ' *Suar hai.*'

A. BAYLEY-DE-CASTRO,
Lieut., I.M.D.

COMBINED MILITARY HOSPITAL,
HYDERABAD (SIND),
May 10, 1930.

IX.—THE HEART SHOT IN GAME

There has lately been a good deal of correspondence in the *Field* over the result of the 'Heart shot in Game Animals' and one well-known sportsman observed that he had frequently found that an animal would drop dead to a heart shot when unconscious of the presence of the shooter, but would generally either take to flight or charge on receiving a bullet through the heart, if it had been watching the shooter.

The above is very true and simply a case of the mind's control over the system. In the first case the animal, all unconscious of danger and with mind at rest, receives a mortal wound and collapses on the spot; in the second instance he is watchful, on the alert, apprehensive of danger, and sub-consciously will be preparing either for flight or a charge, developing into action on being hit even though mortally.

The most notable case of this I have experienced, occurred in connection with a rogue elephant I once shot. The elephant charged me (prior to being fired at) and swerved on receiving my first shot, which missed its brain, and as he charged past me, I found its heart with my second shot, which was very lucky as a heart shot in an Indian elephant is a difficult one. The elephant charged on for about 300 yards and then fell stone-dead driving its tusks into the ground.

R. C. MORRIS.

HONNAMETTI ESTATE,
ATTIKAN P. O., *via* MYSORE.
June 8, 1930.

[An interesting comment on the above subject is J. B. D.'s letter to the *Field*. He writes :

'I am surprised at the amount of correspondence upon which I have long considered, was recognized. Why, even *Homo sapiens* can launch a spear as the heart contracts for the last time.

A good deal depends upon whether the man or animal has seen you and the amount of energy or anger that has been 'distributed.' Any animal is far easier to kill when asleep than when every wire is a live one. It is thus rare for a beast that is lying down to struggle on to its feet when shot through the heart. So numerous are the cases wherein a bullet right through this muscle has failed to cause instant collapse that I ceased to chronicle them.

I would go as far as to say that it is not improbable that a percentage of hits low down in the heart do not prove fatal. When the bullet has passed through above the medial line, death takes place within a few minutes.

Scores of stags must be shot through the heart every year in Scotland and run a hundred yards ere falling ; but, as said, the occurrence is so usual as not to excite comment.

I will give two instances that come to my mind.

I fired at a standing oryx with a service Martini-Henry. She never flinched but galloped up a stiff incline of some 50 yds., started to walk when she had reached the level, proceeded some 30 yds., and rolled over stone-dead. There was a huge ragged tear right through the heart about midway between the apex and the medial line.

A lion came out of a bush about 12 yds. from me. I did not like his look and fired at him with the weapon I had in my hands. This was a double 8-bore carrying a 2½ oz. ball specially hardened for the benefit of elephants. It passed through him as if he were paper. He slewed off, as I had already made a noise, and as he was still going, I gave him the second barrel. This bullet passed through just abaft and high of the heart. He trotted for fully 50 yds. Examination revealed that, although the heart was not actually punctured, it was practically lying loose in the body.

Complete collapse takes place only when the brain, or the vertebræ from the shoulders forward, have been hit.'

A number of interesting letters have appeared in the same paper relative to death from shock in animals. That death may ensue from shock to the system as the result of a bullet grazing the nape of the neck without actually damaging the vertebræ is borne out by two instances given by Mr. J. Sowerby. (*Field*, April 5). The writer saw a rabbit killed with a ·303 bullet. Minute examination showed a slight groove cut in the fur on the nape of the neck. There was a slight bruise under the skin. An Oyster-catcher touched in the same spot by a ·25 R. F. bullet which just scraped the skin, succumbed instantly. Apart from bodily injury the instance related by 'Tulloch Ard' of a hare being killed by the concussion of ·303 bullet which was supposed to have hit the ground below him is interesting.

Commenting on the above Mr. D. D. Lyell writes :

'I see nothing remarkable in such an incident, for I consider the concussion produced by the striking energy of such a projectile might easily produce shock sufficient to stop the action of the heart. Also, it does not follow that the heart in every mammal is in good condition, and I expect in both animals and birds that sometimes it is in a groggy state, for we read of creatures falling dead after getting a fright or due to extreme exertion.

Only the other day I fired a ·256 Mannlicher bullet into a sloping grassy bank, and the result was a hole some 8 in. in depth, and a "divot" rebounded backwards for fifteen paces. Now had a hare or rabbit been sitting over the spot, I am certain it would have been killed with the recoil of the earth which was displaced. Had such an occurrence taken place I believe, however, fur would have been removed, and "Tulloch Ard," in the case he noted, did not mention the hare being marked in any way.'

Mr. Meyer in his book *Birds and Beasts of a Roman Zoo* relates the incident of an apparently healthy well-grown Macaque dropping dead from shock on being startled by a sudden clap of thunder.

Mr. Morris' note provides, we believe, the correct explanation of the behaviour of an animal after being shot through the heart. Taking flight or charging after the fatal shot is a reflex action, a response to the impulse imparted by the brain at the moment of its consciousness of danger. The action ceases when the energy 'generated' by the impulse is expended.—Eds.]

X.—THE COMMON MYNAH (*A. TRISTIS*) AS A PEST IN SEYCHELLES

After a long silence may I invite you again to help us on a question of bird destruction in our small colony. I gladly recall the assistance you gave us some 10 years ago when I happened to visit Bombay.

The Common Mynah (*Acridotheres tristis*) was, it appears, introduced here from India a century ago in order to combat the locust plague. As the plague in question never occurred for the last 50 years to my knowledge and, as no swarms of locusts are known to fly over from Africa to Seychelles, the multiplication of mynahs is giving us some anxiety as they destroy young birds of all sorts in their nests (including pigeons) and have acquired a taste for local fruits of all kinds. I even suspect them strongly of destroying small beetles including the Coccinelids which are so beneficial in combating scale insects.

Before destroying these birds altogether, it seems to be imperative to ascertain from you what are their habits and their food and what harm they are doing in India to your knowledge.

Any assistance from you in that matter would be greatly appreciated.

SEYCHELLES,
February 27, 1930.

P. R. DUPONT,
Director of Agriculture.

[In India the Common Mynah is regarded as a bird which is beneficial to agriculture. Occasionally mynahs eat oats, maize and rice from standing crops, but any damage done by these birds is insignificant in comparison with the good they do by destroying hosts of injurious insects of all kinds. Lefroy & Mason in their report on the 'Food of Birds in India' (*Memoirs, Department of Agriculture*, vol. xii), give details as regards the food of the Common Mynah obtained as a result of the examination of the stomach contents of a series of birds. Of 110 insects taken from 35 birds, 58 were identified as species injurious to agriculture, 5 beneficial, 47 neutral. Twenty birds examined by them had eaten various species of figs, oats, maize and paddy grain. The Mynah is not, in India, generally a fruit eater, though a good proportion of its food consists of various types of wild figs. This is apparently the only class of fruit it habitually eats in this country. It rarely does damage in orchards. Of cereals, maize appears to be its favourite, and damage is done to this crop from mid June till the harvest is ended.

Introduced into other countries, the Mynah has not proved beneficial. It is said to be a great nuisance in New Zealand and Hawaii as it drives away pigeons and fowls and destroys the nests and eggs of birds. Change of environment has produced in this species a change of habit.—EDS.]

XI.—ON THE OCCURRENCE OF THE GREY-BACKED SHRIKE (*LANIUS TEPHRONOTUS* VIGORS.) IN THE SUBURBS OF CALCUTTA

In the Avi-fauna of Lower Bengal the genus *Lanius* is represented by very few species (or sub-species). These are migratory birds, all except one being rather uncommon visitors, straggling into the suburbs of Calcutta in Winter. Recently a specimen of *Lanius tephronotus* (Vigors.) has through the generosity of Dr. Satya Churn Law been presented to the Indian Museum along with some other birds of the District of 24-Parganas. It was obtained so late as April 14, 1930, from the outskirts of a village about 14 miles north-east of Calcutta. Another specimen of this species was obtained by him near the same locality on April 4, 1927. It appears from a comparison of the two birds that the one which has been obtained recently is in perfect breeding plumage, whereas the earlier bird, which had some of its feathers still under moult, was nearly so. Both are full-grown birds, as will appear from their respective measurements and colouration noted below :—

Colouration.—Fore-head, lores and a broad band through the eyes and ear-coverts black; crown, nape, neck, back dark-grey which extends well-nigh to the rump and lesser wing-coverts; feathers of the lower back and rump suffused with rufous; upper tail-coverts rufous; central tail-feathers chestnut—brown, slightly darker than the lateral ones. Wing-coverts and quills blackish—brown, outer primaries narrowly and the inner secondaries broadly edged with rufous. There is no wing speculum of white, and the rufous edges to coverts and quills are very pronounced; below white more or less washed with rufous, which is very pronounced on the breast, flanks, sides of abdomen, vent and under tail-coverts. Bill black, horny towards the gape and the base of the lower mandible; legs and feet brownish—black, the claws darker.

Measurement of specimen obtained on April 14, 1930:—total length 242 mm.; wing 100 mm.; tail 106 mm.; tarsus 28 mm.; culmen 16 mm.

Measurement of specimen obtained on April 4, 1927:—total length 236 mm.; wing 102 mm.; tail 116 mm.; tarsus about 30 mm.

It is worthy of note that *Lanius tephronotus* (Vigors.) is recorded as a bird of very great altitudes, even in the cold weather months when many individuals are expected to be visiting the lower hills and the plains themselves. Those that chance to straggle farthest afield are nearly always found to be immature.

In the collection of the Indian Museum there is only one other specimen of *Lanius tephronotus* (Vigors.) which was obtained from the neighbourhood of Calcutta. It is unsatisfactory for the purpose of comparison, being a very old skin, but the rufescent tone of the plumage and wavy black bars of the underparts point to its being an immautre bird. Blyth has recorded in his catalogue of the Birds of the Asiatic Society of Bengal three specimens from a similar locality, but has not mentioned if any were of immature plumage. There is hardly any other record of the occurrence of this species in the neighbourhood of Calcutta and in the District of 24-Parganas. Nothing is definitely known as to the dates of its arrival in and departure from Lower Bengal. The *Fauna* merely mention it as a winter migrant to the Punjab, U.P., Bihar, Bengal and Burma. In the Sunderbuns, Blyth found it a common bird and also 'on many of the churs (or alluvial banks and islands) in the Ganges and its branches.' The breeding range of the bird is recorded as embracing Gilgit, North Kashmir, Ladak, through Tibet to Western China, its nesting season extending from May to August. It is remarkable that the bird obtained on April 14, 1930, should be found to stay so late in Lower Bengal. An allied migratory

Shrike, viz., *Lanius c. cristatus* Linn, has been observed to stay near Calcutta and in the District of 24-Parganas till the end of April or even as late as May 4, (*The Ibis*, vol. iv, 12th Series, pp. 478–80). Probably it may not be wide of the mark to assume that *Lanius tephronotus* (Vigors.) may remain in Lower Bengal till a similar date before it ventures on its career of finding a mate in the Himalayas and other higher Plateaus.

CALCUTTA, M. N. ACHARJIE,
May, 1930. *Assistant, Zoological Survey of India.*

XII.—BREEDING OF THE GREAT STONE-PLOVER (*ŒDICNEMUS RECURVIROSTRIS*)

On page 750 of the *Journal*, dated October 15, 1929, it is stated that ' there are no authentic records in India of this bird (the Great Stone Plover, *Œdicnemus recurvirostris*) ever depositing its eggs in ploughed fields or land away from river-beds.'

It may interest you to learn that this fine bird breeds regularly on the islands in the two lakes close to Udaipur city, laying its eggs either on earth, or on coarse gravel, or on sheet-rock. There being no sand, it has to do without. Four days ago I found two eggs on soft earth, at the foot of a low shrub, in exactly such a position as is commonly selected by its smaller relative, the Indian Stone-Plover, which is exceedingly common in the country round about here.

UDAIPUR, RAJPUTANA, C. G. CHEVENIX TRENCH.
April 24, 1930.

XIII.—OCCURRENCE OF THE TUFTED POCHARD (*NYROCA FULIGULA*) IN GILGIT

On the 21st of this month, one of my *jamadars* in the Gilgit Scouts saw a strange duck alight on the river, which runs fairly fast at this time of year. Concealing himself behind a convenient rock, he waited for it to be carried down to within range, when he shot it and brought it to me.

It was a male Tufted Pochard (*Nyroca fuligula*) in excellent plumage.

As I gather they are very rarely found in the Himalayas, and this country is so unlike their normal habitat, there being no big lakes, merely streams and flooded rice fields, I thought the matter might interest you.

GILGIT, KASHMIR, M. H. BERKELEY,
February 23, 1930. *Captain.*

[The Tufted Pochard though common in the Peninsula Region of India is rarely seen in Kashmir and the Himalayas.—EDS.]

XIV.—FIRST INDIAN RECORD OF THE EASTERN GREY DUCK *(ANAS PŒCILORHYNCHA ZONORHYNCHA*, SWINHOE) AND THE OCCURRENCE OF THE EASTERN WHITE-EYE *(NYROCA RUFA BAERI* RADDE) IN BIHAR

On March 27, 1929, my collector shot a drake of the Eastern Grey Duck on the Uma Jheel, Pachgachia in the Darbhanga District, Bihar. One specimen of this duck had previously been got at Kentung in the Southern Shan States and another from Taungyi, both in Burma, and these are the only records from India and Burma; so it is most interesting that it should have turned up so far west. My collector realized that it was not the Spotbill when he shot it.

On February 22, 1929, he shot a fine drake of the Eastern White-eye at Baheri quite close to Baghownie. It was the only one amongst a number of the ordinary White-eye (*Nyroca rufa rufa* Linn.), the collector was able to tell it was different before he shot it. I had long hoped for this sub-species to turn up, but out of hundreds of specimens examined by me all proved to be the ordinary White-eye; so it is interesting to find that at long last it has been obtained. Finn got eleven specimens in the Calcutta market in 1896 and since then others have been found in Eastern Bengal, Assam, Manipur and Burma. The drake is easily recognized by its head and neck being glossed with green, but the ducks are not so easily discriminated.

MUSEUM HOUSE,
DARJEELING,
March 18, 1930.

CHAS. M. INGLIS,
F.Z.S., M.B.O.U.

XV.—MIGRATION NOTES FROM KOHAT, N.W.F.P.

The following relating to the migration of birds may possibly interest you or some of your members who study the subject.

Kohat, 1929

Cranes (*Kullam*) began to arrive about their normal date, i.e., latter end August.

Duck.—Abnormally early. Teal seen in August—Gadwal early in September.

Quail.—Unusually early in large numbers and stayed much later than usual, i.e., until beginning of December when they were still being netted in odd patches of millet (*jowari*).

Return Migration, 1930

Cranes.—Normal; end March, first half April, but completed very quickly. During heavy rain first week in April, thousands of *Kullam* were held up unable to cross north over the Tirah Hills into Afghanistan. By April 10, Cranes had completely disappeared.

Quail.—Return migration decidedly weak—local quail-catchers assert that the main body of the birds went north abnormally early this year.

Snipe and Duck.—Very much delayed. There were numerous flocks of duck and teal waiting for the April moon and a lot of snipe.

Stray teal seen in Kohat until April 27. One snipe seen; Kohat, April 30.

Snipe reported Bannu, April 25, fairly plentiful, information from Lt.-Col. W. P. Henry, P. A. V. O. Cavalry, Bannu—normally one expects to see the very last of the snipe at Parachinar—head of the Kurram river—about April the 1st. This year one may say the incidence of the hot weather in the North-West Frontier Province is at least a month late and the migration of birds appears to be correspondingly delayed.

KOHAT,
May 1, 1930.

G. DE LA P. BERESFORD,
Lt.-Col.,
Hodson's Horse.

XVI.—BIRDS OF A HIMALAYAN TORRENT. A STUDY IN BEHAVIOUR

The most delightful of Himalayan birds, those which everywhere meet the eye and which first attract attention by their plumage and behaviour, are the four inhabitants of the mountain streams. What splendid surroundings they have chosen for their habitat! A deep gorge is cut into the range. Its steep flanks are clothed in heavy vegetation. In its bed is a tempestuous torrent, roaring, splashing, leaping amongst boulders, sweeping in one place round bosses of rock, in another place swirling into frothy whirlpools, then for a space flowing smoothly, then rising into a cloud of foam as it breaks into rapids or cascades.

On and in the torrent live four birds. Every visitor to the Himalaya must see them. Their beauty and charm is evident enough: but in addition they give to the philosophical naturalist some material for question and thought.

These birds are—

The White-capped Redstart.—*Chaimarrhornis leucocephalus.*
The Plumbeous Redstart.—*Rhyacornis fuliginosa.*
The Himalayan Whistling Thrush.—*Myiophoneus temmincki.*
The Little Forktail.—*Microcichla scouleri.*

First a note on each of these. The White-capped Redstart is a gorgeous bird, with a black body, chestnut underneath, and a chestnut tail tipped with black. Most conspicuous, however is its white cap, vividly displayed in its flights amongst the stones. It loves to perch on boulders in the torrent, with the waters swirling round about it, standing, as it were, on an island in the foam, bowing its head, jerking its tail, and displaying its striking colours to view. A less elegant bird is the Plumbeous Redstart. The male is a kind of leaden hue with a bright chestnut tail. The female is still plainer, a dull brown, and her tail, instead of being chestnut, possesses a large white patch. The Whistling Thrush is a much larger bird. From a distance it appears uniformly black, but, when seen at close quarters, it is cobalt blue. It loves to rest on the torrent boulders, but it also ascends the wooded slopes and frequents the side ravines. The Little Forktail is a fairy vision, an elusive display of black and white, that seems perfectly adapted to the water-washed stones. It loves the narrow gorge where the torrent is loudest or where it pours over in a steep cascade.

All these four birds frequent the boulders. All are certain to attract attention by the conspicuous movements of their tails.

Competition in the torrent

Here we have four insect-eating birds. They all live in the same gorge: some or all of them may occupy the same stretch of torrent: all are on the same quest, the search for insects along the stream. Are the four birds competitors? Is each robbing the other of its food-supply; or can we see some special adjustment to suit the particular needs of each.

Careful observation will enlighten us on this point. Consider the habits of each species. The White-capped Redstart is a ground feeder. It uses the boulder as a kind of watch-tower from which to spy an insect on the ground. It captures insects of many kinds, all taken on the ground near the edge of the stream. The Plumbeous Redstart has another method. It has specialized in flycatcher activities. To it the boulder is a point of vantage from which to make skilful sallies in the air. At times it may take something from the moist stones, an insect that has been washed up by the torrent: but its pursuits are mainly aerial, and it does not compete with the white-capped species. The Whistling Thrush explores the flanks of the gorge. It is not as confined as the others to the torrent, but gets insects and molluscs on the wooded slopes and in the side ravines. The roughest spots along the torrent are the haunts of the Forktail. It likes the waterfalls and seething rapids. For its captures come from a different source, from minute insects washed into shallow water or tossed ashore by the turbulent stream. To get them it wades out on the water-washed boulders where the rushing torrent sweeps around its legs and envelops it in foam and spray. For the same reason it loves the waterfalls. There it gets many tiny morsels which the spouts of spray toss on to the stones.

Thus we observe that each species has its special way of securing food. All delight in the roar of the torrent; all are in pursuit of insects; all might be thought to be robbing one another of the morsels which abound along the stream. But we see that they are not strict competitors; it is better to regard their activities as interwoven, for each species in pursuit of prey lives its own independent life. Each has its own area of search. The White-capped Redstart explores the ground; the Plumbeous Redstart makes sallies into the air: the Whistling Thrush searches the hill-sides; the Forktail examines the up-tossed spray. Thus, though all kinds do not strictly compete, yet no corner of the stream is left unsearched. This is a general principle in Nature. At first sight many creatures seem to be competitors, but careful observation discloses little differences. There is something in their habits or something in their structure which shows that they are equipped for different activities in the complex struggle of life.

Function of the Tail

No one can observe these torrent birds without remarking on the striking manner in which they expand and oscillate their tails. It is a habit which they all possess to a greater or less degree. Flirting the tail is common amongst birds, but the species of the torrent exaggerate the action. For some reason, which we must investigate, this strikingly excessive movement of the tail is associated with torrent life.

Let us look closely at the behaviour. A White-capped Redstart alights on a boulder. Its tail expands, then oscillates vertically. We see a gorgeous chestnut-fan bordered by a black rim. The same thing happens with the Plumbeous Redstart. The male oscillates its chestnut feathers: the female shows flashes of white. Any slight movement on the part of the bird gives rise to this spreading and trembling of the tail. The Whistling Thrush too spreads its tail when it alights. But it is not the quick oscillating movement of the redstarts; it is more a slow deliberate depression of the tail combined with a spreading of the fan. The Little Forktail, while at rest, keeps its tail in motion, opening it and closing it, displaying its white edges which diverge like a trembling fork.

Now the question arises,—Why is all this? Why should tail-spreading and tail-oscillation be so highly developed in the birds of the stream? First, what is the function of a tail? We are inclined to regard the tail as a steering-organ for directing the aerial movements of the bird. And it may be to some slight extent. But it has other and more important functions. One of these is to act as a brake. Watch a crow alighting on a tree and see how its tail opens like a fan to check it as it comes to rest. A second important function, is an organ of balance. It helps to bring the bird into a state of equilibrium the very moment it alights. Take a wagtail by way of illustration. See the way in which the tail oscillates the instant the bird has alighted on the ground. For a second it moves up and down very rapidly: then the movement dies away as stability becomes secure. The oscillation clearly helps to bring stability and balance to the bird. A bird has to balance a bulky body on a pair of slender legs. The main portion of the load lies in front of the support, but the tail extended backwards is a counter-balance which helps to equalize the weight. Oscillating the tail will help the balance especially at times when stability is insecure. It is like a man trying to walk along a rope. The feat is difficult, but he can make it more easy by carrying a balancing-rod across his body and oscillating it up and down.

Now, with these two ideas in mind, that the tail, by expanding, acts as a brake and by oscillating helps the balance, let us turn again to the torrent birds. Tail movement, as I have said, is very active amongst them. The tail is spread out like a fan and at the same time lowered and raised. The functions of brake and balance are combined. All this occurs at the moment of alighting. When equilibrium is restored, the action ceases. But the slightest movement, for instance if the bird changes its position or merely turns its head for an instant, is sufficient to disturb the equilibrium, with the result that the fan reopens and the oscillating function is resumed.

The question, of course, follows :—If the tail is a brake and a balancing organ, why should the birds of the torrent require it in so conspicuous a degree ? Think for a moment of the habitat of these birds. Round about them are swirling waters. They live on boulders that project above the flood. The boulders are rounded, often slippery with moisture. The birds have to stand on them with outstretched claws, they cannot clutch them as they could the stems of trees. Their haunts are full of instability and insecurity, and the birds have nothing to grip. In such haunts they must maintain themselves by balance ; hence the excessive movement of the tail.

For these brids are, in a sense, alien to this torrent life. By affinity they belong to tree-haunting groups, to birds which habitually grip stems rather than balance themselves on stones. The redstarts are allied to robins, which, of course, ordinarily perch on trees. The Little Forktail belongs to the same sub-family. The Whistling Thrush seems related fo the babblers which skulk in bushes and scrub. The near relatives of these birds, therefore, live in vegetation and when they alight, they can clutch the stems in order to make their position secure. The torrent representatives have diverged from the family. They have found new haunts on slippery boulders. In their ancestors stability was secured by gripping ; they must acquire it by means of balancing. Hence we see the organ of balance employed in this exaggerated way. Chats and robins, of course, do flirt the tail. It shows that they have to balance to some extent. What has happened is that the torrent representatives have had to develop the flirting function because they require it more.

Hence, when a torrent redstart alights, the tail opens, the fan expands. This checks the bird as it comes to the boulder and brings it to rest on the smooth stone. Then immediately the balancing-rod functions, the tail oscillates for a few moments, steadying the bird, securing its equilibrium until its stability of balance is attained.

Hence we have a simple mechanical explanation of the most delightful feature of these birds. The swaying of the tail, the spreading of the fan, the gorgeous view of chestnut in the White-capped Redstart, the snow-white flicker of the Little Forktail; these are the features that attract and delight us, yet they have, as we see, a simple explanation; they are directly associated with equilibration and are necessary to secure the stability of the birds.

LONDON, R. W. G. HINGSTON,
1929. *Major*, I. M. S.

XVII.—BIRDS SEEN ON A TRIP FROM POTTUVIL TO KUMNA, *CEYLON.*

Between April 10 and April 21, 1929.

It may perhaps prove of interest in the future, to anyone who is interested in birds, if I place on record a list of the birds I saw on a trip from Pottuvil to Kumna, a distance of some thirty miles.

The trip lasted ten days, i. e., from April 10 to April 20, and was organized by Mr. George Crabbe, for the purpose of taking various fledglings of such birds as Pelicans, Ibis, Darters, etc., from that extremely interesting, but very little known lagoon, which is not far from the mouth of the Koombakan Oya.

The party consisted of Mr. George Crabbe, Mr. J. Morris Carey and myself, and a taxidermist from the Colombo Museum, who brought cages, etc., with him, for the reception of the fledglings.

The list below is a full list of the birds seen during the journey, and numbers some one hundred and five species. This is quite a fair number, but does not include all the possible species of birds that we might have seen.

Now as regards the Kumna Lagoon, which was our objective. This is a large sheet of brackish water, completely hidden from all view by its growth of mangroves. This mangrove swamp is from forty to fifty yards in depth, and had to be laboriously cut through before the raft which we had brought with us could be launched: and when launched, the raft had to be towed up by our trackers, through the path that they had cut into the swamp, as it was quite impossible to propel it through the mass of cut vegetation by means of a pole.

On emerging from the mangrove swamp into the open water of the lagoon, there was before us one of the strangest and finest sights that a person, keen on natural wild-bird life, could possibly wish to see. I use the word '*natural*' to imply that the birds which nest here have been completely undisturbed by mankind, and are therefore very tame, and can be approached quite close without showing a great deal of fear.

It was very interesting from the ornithologist's point of view to see how the birds which were nesting in this lagoon at the time of our visit, which was about the middle of April, had divided themselves up into roughly distinct zones.

The Spoonbills had all flown, and there were none nesting when we were there; the Ibises had practically all flown too, but there were several indications of where the bulk of the nests had been. The Egrets too, had nearly all flown.

The Mangrove trees, some of them quite big trees, some of them small, and others only bushes, along nearly the whole of the southern side of the lagoon, were tenanted by Pelicans; many nests being in tiers one above the other, and many being alongside one another, practically adjoining. The nests were the usual rather large platforms of sticks, and they all contained two or three young birds, generally two.

The western side of the lagoon was almost entirely tenanted by hundreds of Painted Storks—and next to these, though on rather small detached islands, were Shell Ibises, whilst further on were White Ibises, though unfortunately, both the latter species of young birds had mainly flown, and there were very few fledglings left.

Other small Mangrove islands lying towards the middle of the lagoon, were tenanted by Cormorants. The other two sides of the lagoon were hardly occupied at all by any big birds. The Herons were cosmopolitan and nested practically everywhere, alongside and amongst the Pelicans, Storks, Ibises, Darters, etc. I suppose that with their murderous beaks, they can take care of themselves in any situation.

The Pelicans were very noisy, and it was interesting to see the old birds, which looked far too heavy to fly, launching themselves off their nests into the air, and then flapping their wings rather fast to start with, before they seemed to be able to get their proper balance, and their big webbed feet into a comfortable position. The Painted Storks toc, were very noisy, and there seemed to be a great deal of resentment if a pair belonging to one nest, were to alight, or try to alight, alongside another nest, that is to say if one could judge by the clapping of their bills, which action produces, a noise like the playing castenets or old-fashioned bones. Their young birds, sometimes two or three and sometimes four in a nest, made a tremendous noise, and looked very absurd when they tried to stand up on their long legs. The old birds when intending to alight, dropped their legs at full length just before getting down to their nests, and this seemed to help to steady them in the latter part of their descent. The young Grey Herons were very active and were difficult to catch. They travelled at a considerable rate from branch to branch, and over rushes and under-growth, and when approached closely, immediately withdrew the head and neck, and pointed their rapier-like bills upwards, and when striking, always seemed to aim direct for the eye. One young bird when it was being handed down to me from a branch by a tracker named Gurruwa, pecked at him very suddenly, and just reached the top side of his nose in the corner between the nose and the eye. This blow drew blood, of course, but did not seem to hurt him much, though if it had been a fraction more to the right, I fancy his eye would have been considerably damaged.

The Darters were the most difficult of all the birds to take. To start with, their nests, and rather good nests too, cup-shaped and made of sticks, were about seven to ten feet off the water, and when one got to the nests, the young darters, which by the way are a mass of close-set white, soft, downy feathers, invariably climbed over the side of their nest, and dived straight, like a dropped stone, into the water, and it was then hopeless to try and catch them. From this diving habit, we found that the best way to take the fledglings was for one man to climb towards the nest, and for another to stand directly below, and catch the fledgling in mid-air, on its descent.

We visited the lagoon for four our five days, and Mr. George Crabbe took many photographs, both fixed and moving scenes, and Mr. Carey took several photographs also.

We took for the Colombo Museum the following fledglings :—

6 Darters.
6 Cormorants.
3 Pelicans.
4 Painted Storks.
1 Shell Ibis.
2 White Ibises.
2 Egrettes.
4 Grey Herons.

This family required a great deal of feeding, and we had to employ at first one, and then two Cingalese villagers, to get fish for them every day.

One little point that interested me very much, was the fact that on our second day's visit to the lagoon, two or three common black crows suddenly appeared croaking round about the islands in the middle of the lagoon. It was obvious that the birds had followed our carts down from Pottuvil, and seeing us go out from the camp towards the lagoon, they evidently reasoned that if we went there, there would probably be some 'doings' which might interest them too. Barely had we noticed the birds and wondered at their audacity in following us on to the lagoon to face this mass of other bird-life, and whilst we were speculating as to why they had come, several cormorants flew off their nests close by us, and in a second a crow swooped down and carried off a beautiful blue egg. I had nothing but admiration for these crows, for how clearly had they reasoned out our purpose in going on to the lagoon, and why too should they not share in some of the spoil themselves? Truly are they the most highly evolved of all birds.

Below is a list of all the birds seen on the trip, and I have listed them in accordance with their families, genera and species, in order that a true record may be there for anyone who may care to read, and perhaps improve upon the list, some day :—

LIST OF BIRDS

Family CORVIDÆ

Corvus coronoides culminatus—The Southern Jungle-Crow.
Corvus splendens protegatus—Ceylon House-Crow.

Family TIMALIDÆ

Turdoides griseus striatus—The Ceylon Babbler.
Ropocichla atriceps nigrifrons—The Black-fronted Babbler.
Ægithina tiphia zeylonica—The Ceylon Iora.

Family PYCNONOTIDÆ

Pycnonotus luteolus—The White-browed Bulbul.
Molpastes h. hæmorrhous—The Madras Red-vented Bulbul.

Family TURDIDÆ

Saxicoloides fulicata fulicata—The Black-backed Indian Robin.
Copsychus saularis ceylonensis—The Ceylon Magpie-Robin.
Kittacincla macroura indica—The Shama.

Family MUSCICAPIDÆ

Terpsiphone p. paradisi—The Indian Paradise Flycatcher.
Rhipidura aureola compressirostris—The Ceylon White-browed Fantail Flycatcher.

Family PERICROCOTIDÆ

Lalage sykesii—The Black-headed Cuckoo-Shrike.

Family ARTAMIDÆ

Artamus fuscus—The Ashy Swallow-Shrike.

Family DICRURIDÆ

Dissemurus paradiseus ceylonensis—The Ceylon Large Racket-tailed Drongo.

Family SYLVIDÆ

Acrocephalus stentoreus—Great Reed-Warbler.
Prinia s. socialis—The Ashy Wren-Warbler.
Orthotomus s. sutorius—The Indian Tailor Bird.

Family ORIOLIDÆ

Oriolus xanthonotus ceylonensis—The Ceylon Black-headed Oriole.

Family STURNIDÆ

Acridotheres tristis melanosternus—The Common Ceylon Mynah.

Family PLOCEIDÆ

Ploceus phillipinus—The Common Weaver Bird.
Ploceus manyar flaviceps—The Madras Striated Weaver Bird.
Uroloncha p. punctulata—The Indian Spotted Munia.
Uroloncha striata striata—The White-backed Munia.

Family FRINGILIDÆ

Passer domesticus confuscius—The Burmese House-Sparrow.

Family HIRUNDINIDÆ

Hirundo daurica erythropygia—The Ceylon Swallow.

Family MOTACILLIDÆ

Motacilla flava thunbergi—The Grey-headed Wagtail.
Anthus richardi rufulus—The Indian Pipit.

Family ALAUDIDÆ

Alauda gulgala australis—The Small Nilgiri Skylark.
Mirafra assamica affinis—The Madras Bush-Lark.
Pyrrhulauda grisea—The Ashy-crowned Finch-Lark.

Family NECTARINIDÆ

Leptocoma lotenia.—Loten's Sunbird.

Family PICIDÆ

Chrysocolaptes guttacristatus stricklandi—Layard's Woodpecker.

Family CAPITONIDÆ

Thereicerys z. zelanicus—The Ceylon Green Barbet.
Xantholæma hæmacephala lutea—The Crimson-breasted Barbet.

Family MICROPIDÆ

Tachornis b. batassiensis—The Bengal Palm-Swift.
Hemiprocne coronata—The Indian Crested Swift.

Family CUCULIDÆ

Clamator jacobinus taprobanus—The Ceylon Pied Crested Cuckoo.
Penthoceryx sonneratti waiti—The Ceylon Bay-banded Cuckoo.
Eudynamis scolopaceus scolopaceus—The Indian Koel.
Rhopodytes viridirostris—The Small Green-billed Malkoha.
Taccocua leschenaulti—The Southern Sirkeer Cuckoo.
Centropus sinensis parroti—The Southern Crow-Pheasant.

Family PSITTACIDÆ

Psittacula e. eupatria—The Large Ceylonese Paroquet.
Psittacula krameri manillensis—The Rose-ringed Paroquet.

Family MEROPIDÆ

Merops orientalis orientalis—The Common Indian Bee-Eater.

Family ALCEDINIDÆ

Ceryle rudis leucomelanura—The Indian Pied Kingfisher.
Ceyx t. tridactylus—The Indian Three-toed Kingfisher.
Ramphalcyon capensis gurial—The Brown-headed Stork-billed Kingfisher.
Halcyon smyrnensis generosa—The Ceylon White-breasted Kingfisher.

Family BUCEROTIDÆ

Anthraceros coronatus coronatus—The Malabar Pied Hornbill.
Lophoceros g. gingalensis—The Ceylon Grey Hornbill.

Family FALCONIDÆ

Spizaëtus cirrhatus ceylonensis—The Crested Hawk-Eagle.
Spilornis cheela spilogaster—The Ceylon Serpent-Eagle.
Haliaëtus leucogaster—The White-bellied Sea-Eagle.
Haliastur indus—The Brahminy Kite.
Milvus migrans govinda—The Common Pariah Kite.
Astur trivirgatus trivirgatus—The Crested Goshawk.

Family COLUMBIDÆ

Dendrophasa Pompadora—The Pompadour Green Pigeon.
Muscadivora ænea pusilla—The Imperial Green Pigeon.
Chalcophaps indica robinsoni—The Ceylon Emerald Dove.
Columba livia intermedia—The Indian Blue Rock-Pigeon.
Streptopelia chinensis ceylonensis—The Ceylon Spotted Dove.

Family PHASIANIDÆ

Pavo cristatus—The Common Peafowl.
Gallus lafayettii—The Ceylon Jungle-Fowl.
Coturnix coramandelica—The Black-breasted Quail.

Family JAÇANIDÆ

Hydrophasianus chirurgus—The Pheasant-tailed Jaçana.

Family ROSTRATULIDÆ

Rostratula bengalensis bengalensis—The Painted Snipe.

Family STERNIDÆ

Chelidonias leucopareia indica—The Indian Whiskered Tern.
Gelochelidon n. nilotica—The Gull-billed Tern.
Sterna albifrons sinensis—The White-shafted Tern.
Sterna albifrons saundersi—The Black-shafted Tern.

Family CHARADRIIDÆ

Charadrius dubius curonicus—The Little Ringed Plover.
Pluvialis dominicus fulvus—The Eastern Golden Plover.
Himantopus h. himantopus—The Black-winged Stilt.
Tringa stagnatilis—The Marsh-Sandpiper.
Tringa hypoleucos—The Common Sandpiper.
Tringa glareola—The Wood-Sandpiper.
Tringa t. totanus—The Redshank.
Erolia minuta—The Little Stint.

Family SCOLOPACIDÆ

Capella stenura—The Pin-tailed Snipe.

Family PELECANIDÆ

Pelecanus phillipensis—The Spotted-billed Pelican.

Family PHALACROCORACIDÆ

Phalacrocorax javanicus—The Little Cormorant.
Phalacrocorax fuscicollis—The Indian Shag.
Anhinga melanogaster—The Indian Darter.

Family PLATALEIDÆ

Platalea leucorodea major—The Spoonbill.

Family IBIDÆ

Threskiornis melanocephalus—The White Ibis.

Family CICONIDÆ

Dissura episcopus episcopus—The White-necked Stork.
Leptoptilus javanicus—The Smaller Adjutant.
Ibis leucocephalus—The Painted Stork.
Anastomus oscitans—The Open-Bill.

Family ARDEIDÆ

Ardea purpurea manillensis—The Eastern Purple Heron.
Ardea cinerea cinerea—The Common Grey Heron.
Egretta intermedia intermedia—The Indian Smaller Egret.
Bubulcus ibis coromandus—The Cattle Egret.
Ardeola grayi—The Pond Heron.
Nycticorax n. nycticorax—The Night-Heron.

Family PHŒNICOPTERIDÆ

Phoenicopterus ruber antiquorum—The Common Flamingo.

Family ANATIDÆ

Nettapus coromendelianus—The Cotton Teal.
Dendrocygna javanica—The Whistling Teal.
Querquedula querquedula—The Garganey Teal.

Family PODICEPIDÆ

Podiceps ruficollis capensis—The Indian Little Grebe.

HUNGERFORD, GEORGE BROWN.
May, 1930.

XVIII.—A LIST OF SOME BIRDS OF THE SEVEN HILLS OF NAINI TAL. U.P.

The area from which this list was made includes the Naini Tal Lake 6,350 ft., and the seven hills from their summits down to 5,000 ft. The seven hills are Cheena 8,568 ft., Alma 7,792, Sher Ka Dauda 7,869, Laria Kanta 8,144, Agarpatta 7,689, Handi Pandi 7,180, Deopatta 7,987.

A radius of four miles from the lake on all sides would cover the area.

The hills are steep and shaly. There is considerable broken ground.

The forest is dense in parts with thick undergrowth. In places there are open grassy slopes.

The forest consists of the three oaks—*karshu*, *maru*, *bnuj*—cypress, rhododendron, ash, horse chestnut, ilex, some deodars, blue pines (at 5,000 ft.), walnut and small bamboos.

The hills are so steep that there are no water-courses worth mentioning except during the rains.

The plains are fourteen miles below and the snow range sixty-six miles away.

There are no higher ranges between Cheena and the snow range.

The birds consist of residents, those passing through on migration, and those that move up or down according to the season.

Crows, magpies, jays, tits, sibias, nut-hatches, thrushes, blackbirds, woodpeckers, tree-creepers, streaked laughing-thrushes, vultures, kites, partridges, pheasants and owls are residents.

Laughing-thrushes, mynas, minivets, flycatchers, hoopoes bulbuls, parrots, warblers move up or down the hills according to season. They are summer residents in Naini Tal.

Redstarts, grosbeaks, cormorants, grebes, rosefinches, black-throated thrushes, Altai hedge-sparrows, and goldfinches arrive or can be seen in the winter and leave in the early summer.

No doubt there are many more birds needed to make the list at all approximate to the actual number that could be seen; but the list gives all that can be seen by fairly frequent and careful observation and search.

The birds are placed according to the order given in the Second Edition of the *Fauna of British India Birds*, by Stuart Baker.

1. **Himalayan Jungle Crow. Corvus coronoides intermedius.**
A very common resident.

2. **The Red-Billed Blue Magpie. Urocissa melanocephela occipitalis.**
A common resident. They come into the station more frequently and in greater numbers in the winter. They bathed and drank out of a bird bath in the garden.

3. **The Black-throated Jay. Garrulus lanceolatus.**
A common resident. They frequent the station and gardens more often in the winter. They also used the bird bath.

4. **The Himalayan Jay. Garrulus bispecularis bispecularis.**
A common resident of the surrounding woods.

5. **The Green-backed Tit. Parus monticolus monticolus.**
A very common resident.

6. **The Crested Black Tit. Lophophanes melanolophus.**
A common resident. A pair nested in my garden in March.

7. **The Brown-crested Tit. Lophophanes dichrous dichrous.**
Not common. Seen in the forests.

8. **The Northern Yellow-cheeked Tit. Machlolophus xanthogenys xanthogenys.**
Often seen in July and August in the forests.

9. **The Red-headed Tit. Ægithaliscus concinus iredalei.**
A very common resident seen in both gardens and forests.

10. **The White-tailed Nuthatch. Sitta himalayensis**
A very common resident : goes about in hunting parties with tits and yellow-naped ixulus and the grey-headed warbler.

11. **The Himalayan White-crested Laughing-Thrush. Garrulax leucolophus leucolophus.**
Seen occasionally at 5,000 feet. : once at 5,800 feet.

12. **The White-throated Laughing-Thrush. Garrulax albogularis albogularis.**
A common resident. Goes about in large and noisy flocks in the forests, and comes into the gardens in the winter.

13. **The Red-headed Laughing-Thrush. Trochalopterum erythrocephalum erythrocephalum.**
Occasionally seen in the forests at 7,500 feet or higher ; but rare.

14. **The Simla Streaked Laughing-Thrush. Trochlopterum lineatum griseicentior.**
A very common resident in gardens and forests.

15. **The Striated Laughing-Thrush. Grammatoptila striata striata.**
Seen in the summer from 5,000 to 7,000 feet in the forests ; not common.

16. **Vigor's Rusty-cheeked Scimitar-Babbler. Pomatorhinus erythrogenys erythrogenys.**
Seen and heard in the summer months and autumn.

17. **Baker's Rusty-cheeked Scimitar-Babbler. Pomatorhinus erythorgeuys haringtoni.**
Seen and frequently heard during the summer and autumn.
Lurks in the undergrowth about the station.

18. **The Black-headed Sibia. Leioptila capistrata capistrata.**
A very common resident : abundant in gardens and forests.

19. **Hodgson's Blue-winged Siva. Siva cyanouroptera cyanouroptera.**
A pair seen frequently in April drinking and bathing in the garden bird bath.

20. **The Yellow-naped Ixulus. Ixulus flavicollis flavicollis.**

Seen throughout the year, but more numerous in July and August. Small flocks seen associating with tits, warblers, silias, and nuthatches.

21. **The Indian Red-billed Liothrix. Liothrix lutea callipyga.**

Seen throughout the year, but more often in the winter when small flocks were frequently met with. Small flocks used the bird bath almost daily during December and January. Seen up to 8,000 feet in July, but mostly at 6,800 feet.

22. **The Red-winged Shrike-Babbler. Pteruthius erythropterus.**

Seen all the year. Abundant in the forests in July and August.

23. **The Himalayan Black Bulbul. Microscelis psaroides psaroides.**

Numerous flocks from December to April. Further flocks in September.

24. **The Rufous-bellied Bulbul. Hemixus maclellandi maclellandi.**

Seen frequently from March to September in the forests up to 7,000 feet.

25. **The Punjab Red-vented Bulbul. Molpastes hæmorrhous intermedius.**

Not at all common. Seen from February to September occasionally at 5,500 feet or lower.

26. **The White-cheeked Bulbul. Molpastes leucogenys leucogenys.**

Common in summer. Very few from January to April.

27. **The Himalayan Tree-creeper. Certhia himalayana himalayana.**

A common resident in forest and garden.

28. **The Indian Bush-Chat. Saxicola tarquata indica.**

Occasionally seen in June and July at 5,000 feet.

29. **The Dark-grey Bush-Chat. Oreicola ferrea ferrea.**

A very common bird in garden and forest from March to October.
Seen in December, January and February.

30. **The Western Spotted Forktail. Enicurus maculatus maculatus.**

Two seen in February, one in March and one in August in mountain streams in which there was very little water at 5,500, 6,000 and 6,500 feet.

31. **The Blue-fronted Redstart. Phœnicurus frontalis.**

A very common visitor from December to March at about 6,500 feet.

32. **The White-capped Redstart. Chaimarrhornis leucocephala.**

A fair number about the lake—6,350 feet—from December to April: after that none.

33. **The Plumbeous Redstart. Rhyacornis fuliginosa fuliginosa.**

A fair number about the the lake from December to March.

34. **The Red-flanked Bush Robin. Ianthia cyanura rufilata.**

Very common from December to March down to 6,500 feet.

35. **The White-collared Blackbird. Turdus merula albocinctus.**

A resident. They come into the station during the winter. They used the bird bath very often.

In the summer they ascend the hills to 7,000 or 8,000 feet and breed there.

36. **The Grey-winged Blackbird. Turdus boulboul.**

A resident. Commoner in the station in the winter when seen with the white-collared blackbird and grey-headed thrush and black-throated thrushes. They used the bird bath frequently.

37. **The Grey-headed Thrush. Turdus castaneus castaneus.**

Occasionally seen in the winter in February and March in company with other thrushes. Not common.

38. **The Black-throated Thrush. Turdus albogularis.**

Very common from December to March; after that none.

39. **The Himalayan Missel-Thrush. Arceuthornis viscivorus bonapartei.**
Seen at 8,000 feet in February and March.

40. **The Small-billed Mountain-Thrush. Oreocincla dauma dauma.**
Occasionally seen at 8,000 ft. in July.

41. **The Chestnut-bellied Rock-Thrush. Monticola erythrogastra.**
Two seen in February at 7,500 feet.

42. **The Blue-headed Rock-Thrush. Monticola cinclorhyncha.**
Seen from May to September at 7,000 to 8,000 feet. Breeds locally.

43. **The Himalayan Whistling-Thrush. Myiophoneus temminckii temminckii.**
A very common resident on hills, valleys and gardens and forests. Frequently uses the bird bath, and seen in rocky country away from water. This bird has a pretty song and is the only thrush at Naini Tal which sings frequently and is often heard. The grey-winged and white-collared blackbirds do not sing much here.

44. **The Altai Hedge-Sparrow. Laiscopus himalayanus.**
Flocks seen in February.

45. **The White-browed Blue Flycatcher. Cyornis superciliaris superciliaris.**
Fairly common from 22nd March to end of September.

46. **The Verditer Flycatcher. Stoparola melanops melanops.**
Very common from 3rd March to end of September. Most seen in April, May and June.

47. **The Brown Flycatcher. Alseonax latirostris poonensis.**
Not common. Seen in September.

48. **The Grey-headed Flycatcher. Culicicapa ceylonensis ceylonensis.**
March to August and fairly common.

49. **The Rufous-bellied Niltava. Niltava sundara sundara.**
Two pairs seen in July at 8,000 feet and one in September.

50. **The Yellow-bellied Flycatcher. Chelidorhynx hypoxanthum.**
Two seen in March and two in April.

51. **The Short-billed Minivet. Pericrocotus brevirostris brevirostris.**
Very common from 10th February to October.

52. **The Dark-grey Cuckoo-Shrike. Lalage melaschista melaschista.**
One in early September.

53. **The Himalayan Black Drongo. Dicrurus macrocercus albirictus.**
Seen from March to August ; but not common.

54. **The Himalayan Grey Drongo. Dicrurus leucophæus stevensi.**
April, May and June and September and early October.
Groups of 10 to 12 seen at times. Commoner than the black drongo.

55. **Hume's Willow-Warbler. Phylloscopus humii.**
Passing through in May.

56. **The Greenish Willow-Warbler. Acanthopneuste nitidus viridans.**
Passing through in May.

57. **The Large-crowned Willow-Warbler. Acanthopneuste occipitalis occipitalis.**
Passing through in May and September.

58. **The Kashmir Grey-headed Warbler. Seicercus xanthoschistus albosuperciliaris.**
Very common from April to October.
Found a nest with young at 8,000 feet on 23rd May. Saw one of these warblers feeding a young Himalayan cuckoo on the 30th May.

59. **The Brown Hill-Warbler. Suya crinigera crinigera.**

Occasionally seen in the summer on the open grassy slopes of the hills.

60. **The Common Myna. Acridotheres tristis tristis.**

Very common in the summer. A rapid decrease during September and October.

61. **The Black and Yellow Grosbeak. Perissospiza icteroides icteroides.**

A large number in the oak forests at 7,000 to 8,000 feet during December to April.

62. **The Spotted-winged Grosbeak. Mycerobas melanoxanthus.**

A considerable number seen during January to the end of February at 7,000 to 8,000 feet in the forests.

No allied grosbeaks were seen at all although carefully looked for.

63. **The Pink-browed Rose-Finch. Propasser rodochrous.**

Occasionally seen from December to March.

64. **The Himalayan Gold-Finch. Carduelis caniceps caniceps.**

Flocks seen in February.

65. **The Red-browed Rose-Finch. Callacanthis burtoni.**

Quite common from December to April. Large flocks seen in the forests, and in the station feeding on the dried seeds of the mountain ash.

No other find was as common as this one.

66. **The Himalayan Green-Finch. Hypacanthis spinoides spinoides.**

Common from June to October. Seen occasionally in December and in January. Occurred in pairs or in small flocks.

67. **The Indian House-Sparrow. Passer domesticus indicus.**

A common resident.

68. **The Kashmir Cinnamon Sparrow. Passer rutilans debilis.**

Fairly frequent in June, July and August.

69. **The Eastern Meadow-Bunting. Emberiza cia stracheyi.**

Seen in February, March and September.

70. **The White Wagtail. Motacilla alba dukhunensis.**

Occurs in March and April and again in August and September but not very numerous.

71. **The Grey Wagtail. Motacilla cinerea caspica.**

Very numerous in March, April and September : a few up to December.

72. **The Indian Tree-Pipit. Anthus hodgsoni hodgsoni.**

Occurs in March.

73. **The Brown Rock-Pipit. Anthus sordidus jerdoni.**

Seen in May.

74. **The Northern White-Eye. Zosterops palpebrosa elwesi.**

Arrived on the 18th March and stays till October.

75. **Blyth's Yellow-backed Sunbird. Æthopyga nepalensis horsfieldi.**

Frequently seen in the garden in June and July, feeding on the wild pomegranate flowers.

76. **The Scaly-bellied Green Woodpecker. Picus squamatus squamatus.**

A resident.

77. **The Western Himalayan Pied Woodpecker. Dryobates himalayensis himalayensis.**

A resident.

78. **The Brown-fronted Pied Woodpecker. Dryobates auriceps.**

A common resident. It frequents the garden. It fed on cocoanut put out for the tits pecking very vigorously at the nut and swinging round and round as the nut twisted.

79. **The Great Himalayan Barbet. Megalaima virens marshallorum.**

A common resident. It is heard most in the spring and summer.

80. **The European Cuckoo. Cuculus canorus.**

April to July, but not common.

81. **The Himalayan Cuckoo. Cuculus optatus.**

Common from April to July.

82. **The Large Hawk-Cuckoo. Hierococcyx sparveroides.**

April to July: seen and heard in the forests; but not common.

83. **The Himalayan Slaty-headed Paroquet. Psittacula schisticeps schisticeps.**

Many in June to October up to 8,000 feet. They go down lower in the winter, when they are not usually seen above 5,000 feet.

84. **The Himalayan Pied Kingfisher. Ceryle lugubris guttulata.**

Seen by the lake in January.

85. **The Common Indian Kingfisher. Alcedo atthis bengalensis.**

A few are resident.

86. **The Indian White-breasted Kingfisher. Halcyon smyrnensis fusca.**

Several seen in June, July and August at Sukha Tal.

87. **The European Hoopoe. Upupa epops epops.**

Arrived on April 5th, leave by the end of September.

88. **The Alpine Swift. Micropus melba melba.**

Flocks in September.

89. **The Common Indian House-Swift. Micropus affinis affinis.**

Arrived 15th March, remain until October.

90. **The Himalayan Wood-Owl. Strix nivicola.**

Occasionally seen.

91. **The Himalayan Brown Wood-Owl. Strix indranee newarensis.**

Occasionally seen.

92. **The Western Spotted Scops Owl. Otus spilocephalus huttoni.**

Resident. One seen which had markings on the back of its head which resembled two eyes and beak.

93. **The Western Himalayan Barred Owlet. Glaucidium cuculoides cuculoides.**

Resident.

94. **The Western Collared Pigmy Owlet. Glaucidium brodiei brodiei.**

Resident.

95. **The Black Vulture. Sarcogyps calvus.**

96. **The Himalayan Grifon. Gyps himalayensis.**

97. **The White-backed Vulture. Psuedogyps bengalensis.**

98. **The Egyptian Vulture. Neophron percnopterus percnopterus.**

99. **The Bearded Vulture. Gypaëtus barbatus hemachalanus.**

100. **The Kestrel. Cerchneis tinnunculus interstinctus.**

101. **The Imperial Eagle. Aquila heliaca heliaca.**

102. **The Eastern Steppe Eagle. Aquila nipalensis nipalensis.**

103. **The Indian Black Eagle. Ictinaëtus malayensis perniger.**

104. **The Himalayan Fishing-Eagle. Ichthyophaga humilis plumbeus.**

105. **The Brahminy Kite. Haliastur indus indus.**

Seen in winter about the lake.

106. **The Common Pariah Kite. Milvus migrans govinda.**

A common resident.

107. **The Long-legged Buzzard. Buteo rufinus rufinus.**

108. **The Wedge-tailed Green Pigeon. Sphenocercus sphenurus.**
July and August: 5,000 to 8,000 ft.

109. **The Indian Rufous Turtle-Dove. Streptopelia orientalis ferrago.**
Very common, arrives 15th March and stays till October.

110. **The Indian Spotted Dove. Streptopelia chinensis suratensis**
Seen on the cart road in August at 5,500 feet.

111. **The Little Brown Dove. Streptopelia senegalensis cambaiensis.**
Seen three times in August at 6,500 feet: one flew into my garden.

112. **The Common Red Jungle-Fowl. Gallus bankiva murghi.**
Resident, but not common.

113. **The Cheer Pheasant. Catreus wallichii.**
Resident, but seen often.

114. **The Koklas. Pucrasia macrolopha macrolopha.**
Resident, not often seen.

115. **The White-crested Kalij. Gennæus hamiltoni.**
Resident: frequently seen.

116. **The Common Hill-Partridge. Arborophila tarqueola tarqueola.**

117. **The Indian Black Partridge. Fancolinus fancolinus asiæ.**
Rarely seen.

118. **The Indian Whiskered Tern. Chlidonias leucopareia indica.**
A few on the lake in September.

119. **The Little Ringed Plover. Charadrius dubius jerdoni.**
Two seen at Sukha Tal in September.

120. **The Green Sandpiper. Tringa ochrophus.**
One seen at Sukha Tal in September.

121. **The Woodcock. Scolopax rusticola.**
One seen on 3rd April.

122. **The Large Cormorant. Phalacrocorax carbo sinensia.**
Four on the lake from January to April.

123. **The Mallard. Anas platyrhyncha.**
Small flocks on the lake in September.

124. **The Little Grebe. Podiceps ruficollis capensis.**
Two seen in the lake during January and February.

NAINI TAL.
May, 1930.

CORRIE HUDSON,
Major General.

XIX.—NOTES ON THE STAR TORTOISE *(TESTUDO ELEGANS)*

Testudo elegans is usually found in the sandy flats at Rameswaram; its food consists of a succulent plant botanically called *Cissus quadrangularis* which usually grows in association with the Euphorbia (cactus) plant.

An adult specimen was kept by me in captivity for more than six months at Rameswaram, and fed on the plant under reference but, owing to the superstitious sentiments of the people, that rearing tortoises at home is ominous to the welfare of family life and to its neighbourhood, I had to do away with it as a donation to the American College at Tallakulam, Madura.

During my collecting tours in North Travancore I have observed a peculiar method, of killing these reptiles for food, practised by the hill-tribes (Paliyars) by thrusting the finger into the anus and when the head of the tortoise is protruded, it is suddenly fixed between the teeth tightly, the body is twisted round and round till the neck has been dislocated, when the carcase is put into the fire and consumed before it is fully roasted.

MADURA, R. SHUNKER NARAYAN PILLAY.
June 7, 1930.

XX.—CAPTURING MONITOR LIZARDS AND PYTHONS

The Monitor lizard to which Mr. Beni Charan Mahendra refers is regarded as a great delicacy by the '*jungli*' coolies of Nagpur, who form the backbone of our labour forces; and they invariably use the methods he mentions to obtain these.

When I was on this garden in 1927 one man, Sonia Oraon, spent a great deal of the time when he was supposed to be hoeing in searching the drain sides in the tea for lizards' burrows. With his hoe he would cut away the earth until the tail was visible, this he seized and dragged the lizard out. After this his method was to maim the poor wretch by breaking the joints of all its legs, thus keeping it alive until he was able to take it home.

On my return after an absence of two years I find that Sonia has grown more ambitious, although naturally such a conservative would not change his methods; he now flies at bigger game and pythons are included in his game register. I watched him catch one which measured 16 feet and which was exceptionally bulky. It was in scrub jungle travelling slowly when we located it; having sent a pal to its front end to attract its attention, Sonia literally dived into the scrub and quickly emerged dragging the snake backwards by its tail. It was then neatly persuaded to place its head in a wire noose, what time another was slipped along its body from the tail end.

The usual method of catching pythons is to throw a long bamboo across them, and roll it along the body to the neck, when, provided the ends of the bamboo are held down, the snake is quite helpless and can be killed or tied up.

I trust the above may be of interest to you but I fear that there is nothing new in what I write.

RYDAK, EASTERN DUARS, FRANK C. RICHES.
June, 1930.

XXI.—MASHEER FISHING IN BURMA

The article published in your number of February 15, 1929, by Mr. A. Macdonald on 'Masheer in Burma and their Habits' was a most interesting one and is undoubtedly of great help to all anglers resident in Burma or visitors to Burma. Up to date no book, to my knowledge, has been published on the fishing in Burma which, to those who know it, would fill a tome. Skene Du in his book '*The Mighty Masheer*' flits very shallowly over the fishing in Burma and likewise does Thomas in his '*Rod in India*.' I can only attribute this to their lack of information on the fishing in this part of the world. Mr. Macdonald has confined himself solely to a short trip to the confluence of the Mali and Nmai Hkas which is an extremely small area. The Mali and Nmai Hkas from their upper reaches to the confluence in themselves supply any amount of meat if a book were contemplated. Apart from the two main streams mentioned, there are numerous other extremely good fishing streams, some in administered, and some in unadministered territory, which have only been mentioned over a noggin of ale or several gins and bitters in a club. If an author could be found, I am certain he could obtain very valuable information of most of the streams in Burma from various people who have had personal experience of them. I can think of no better author than Mr. Macdonald who, apart from his knowledge of fish and skill in writing, knows many people who could give him all the information he required. For instance the book could be chapterized into the following :—

The Mali Hka and its Tributaries, the Nmai Hka and Tributaries, Fishing in North and South Triangle, The Chin Hills, The Hukawng Valley and the Naga Hills, Upper Chindwin—besides the above there are some good streams that feed the Irrawaddy round about Bhamo.

However, this is rather getting away from an incident I should like to mention and this should be read in conjunction with Mr. Macdonald's article where he leaves to the imagination a fish he 'had on' for just under 2 hours and one which R.T. struggled with and lost after a two hours' fight. I can beat both these incidents and were it not for the fact that I am able to produce perfectly good collaboration, my incident would be classified as an '*Anglers Arms*' yarn. The incident in question occurred during the Naga Hills Expedition on the Namhpok Hka. The Column arrived on the Namhpok at 3.20 p.m. on March 10, 1930—the weather was dull and cloudy and after the camp had been pitched, H.E.J. and I decided to try our luck. H.J.M. stayed behind on a job of work. H.E.J. worked up-stream and I in the opposite direction—the time now was 4.40 p.m. Immediately below the camp I struck what looked like an ideal spot, a broad, fast rapid running into a very deep pool, at the end of the rapid a side stream hit the pool in deep water. I fished the rapid with no success. When opposite the stream, fishing deep, I was taken by a fish at 4.58 p.m. the strike of the fish was unlike that depicted in fishing yarns, i.e., a strike that almost takes the rod out of one's hands and then a scream—I realize this will draw a comment—instead, the fish took the spoon in what I took to be '*Well, I am not really hungry, but I suppose I had better have it*' sort-of-a-way. The reel screamed and the line flashed out for about 40 yards after which nothing happened. I hung on at great risk to rod and line for about 10 minutes and then decided I had been snagged and the fish had got off. The water was too deep and the current too strong for any salvage work with a bamboo to be done, so handing the rod to my Orderly and taking the end of the line I heaved. Instead of being snagged and the fish off, the fish was well on and d——d nigh took the rod and the Orderly. I grabbed the rod and began playing what I imagined to be a Grand-mother. However the fun was by no means fast or furious as the old lady merely sank and stayed nose-on to the current. Another ten minutes hard pulling made no impression, so stones were resorted to and this only produced a slight movement. I then decided the 'wait and see' policy was the most sound; so turning over my rod I sat down and got a fire going to keep off sandflies and keep myself warm. The time now was about 6 p.m. and getting dark. I sent for a torch. At about 7.30 p.m. H.E.J. arrived and was convinced I was playing a sunken log. But shortly after his arrival the fish made a movement. At about 8.30 p.m. the fish started very slowly up-stream and I helped as much as possible by pulling him in that direction. I had not seen the brute up to this period and H.E.J. was convinced I was into a '*mugger*'; for myself I imagined I had broken Colonel Rivett-Carnacs' record. The fish now seemed to be wearying a bit and I was able to reel in a few yards of line—the process was slow; but at 9 p.m. the fish broke the surface and relieved us of all doubts of 'mugger.' In the torch light the fish looked enormous; so it was decided, in order to hurry matters to shoot him. At 9.30 p.m. H.E.J. shot the fish with a 22 Rifle and he was hauled out by no means dead. After various guesses it was decided the fish weighed not less than 42 lbs. On arrival at Camp 3 scales were produced, two Lewis Gun balance springs registering 20 lbs. each, and H.E.J's. 30 lbs. scale. The three scales were hung on to each other and the fish weighed—it registered 20 lbs. on each of the 20 lbs. scales and 28 on H.E.J's. scale. After this weighment great brains decided the weight of the fish was 48 lbs. The measurements of the fish were then taken and the weight worked out by formula; this showed the fish to be approximately 28 lbs. which seemed ridiculous in view of the fact that it had taken 4¼ hours to land and only then after having been shot through just below the dorsal fin. To cut a long story short, the fish was weighed next morning in two bits and was exactly 28 lbs.

From the above account can it not be justly surmised that Mr. Macdonald's fish was probably a little under 14 lbs. and R.T's. just about 14 lbs.

The tackle used was a Norse Murdoch 11½ ft. greenheart rod, Manton's special Lignum Vitæ dressed line of 36 lbs. breaking strain, stout killing wire trace and Mantons No. 7 gilt and silver Hog-Back Spoon. The river was fast and deep and I was taken about 200 yards.

Finally, will some kind reader please inform me how it is possible to weigh a fish of 50 lbs. without destroying, it when in possession of three scales capable of registering 20, 20 and 30 lbs. respectively.

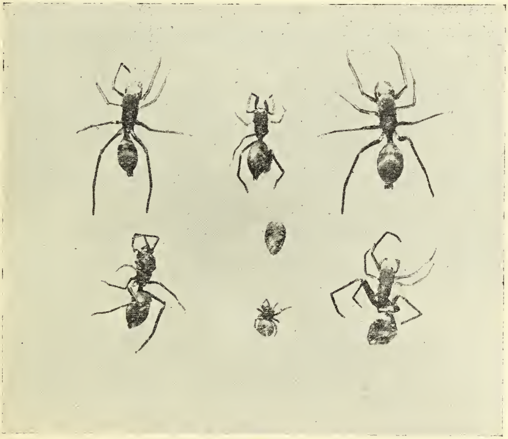
C/o THOS. COOK & SONS,
RANGOON.

S. C. MACGREGOR,
Captain.

XXII.—ANT-MIMICING SPIDERS AS VICTIMS OF WASPS.

(*With a photo*)

I am sending you a photograph of the spiders obtained from the cell of a wasp. I was not able to get at the wasp but the interest of the photograph lies in the fact that though such close mimics of ants as all but one of the spiders were, they were not able to



Ant-Mimicing Spiders obtained from the cell of a wasp.

escape from being caught and stored as food for its young by a wasp.

DEPARTMENT OF AGRICULTURE, K. KUNHI KANNAN,
MYSORE STATE, *Entomologist.*
May 8, 1930.

[It is impossible to identify the spiders in question from the photograph, but it is evident that the remarkable likeness to ants which these spiders exhibit was ineffective as a protection against the attacks of the wasp.

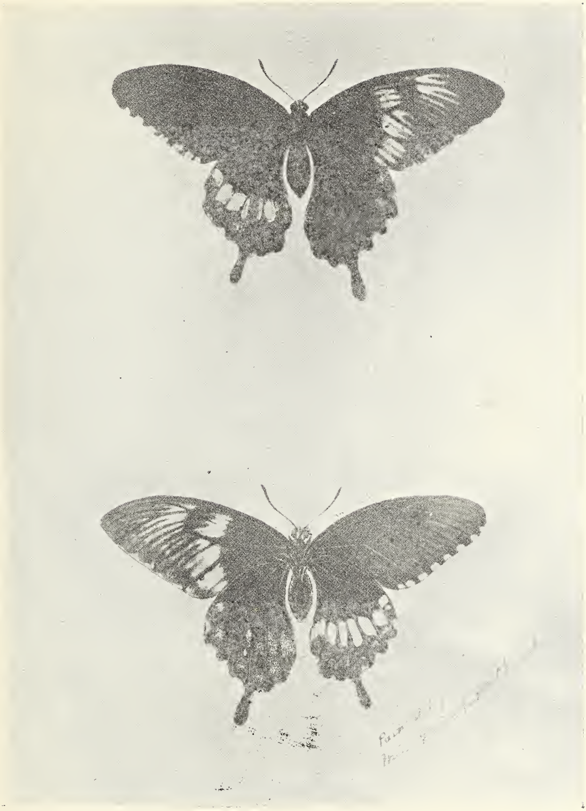
Professor E. B. Poulton (Zool. Anzeiger, 1929. Akad. Verlgsgellsch. m. b. H. Leipzig, p. 79), discusses the subject of 'Ants as Models for Mimicry.' He brings together a few important observations of naturalists who, by their experience of animal life in the tropics, are convinced that the widespread mimicry of ants by various types of insects is advantageous. It is a mistake to believe that even the most formidable or most distasteful insect or the most successful mimic is immune from attack. If it were so, such a species would speedily succumb to the deadliest enemy of all—their own unchecked population. The observations of various authors who have contributed to this vast subject lead directly to the conclusion that it is advantageous for insects and other forms to be associated with ants, for, in spite of attacks by other enemies, ants are on the whole remarkably well protected and owe to this, in combination with their communal life, the fact that they are the most successful insects, and probably, except for man, the most successful animals in the world.—EDS.]

XXIII.—A FREAK *PAPILIO POLYTES ROMULUS* Cr. ♀

(*With a plate.*)

I attach herewith a painting of a ♀ *Papilio polytes romulus*, Cr. drawn to scale. This specimen, I think, is unique and will interest collectors. It was taken at Dehra Dun, U.P., by Miss Floris Tarachand in October 1924. As will be seen, the right wings are those of the ♀ which resembles *Papilio hector*, L, and the left wings are those of the ♀ which resembles the ♂, except that there are two splashes of red on the white discal band on upper side. It is also curious that the wings on the left are a good deal smaller than those on the right. The specimen figured has very generously been presented to me by Miss Floris Tarachand and is now in my collection.

MUSSOOREE, U.P., O. C. OLLENBACH.
June 12, 1930.



A Freak example of *Papilio polytes romulus* Cr. ♀

XXIV.—NOTES ON *PARANTIRRHŒA MARSHALLI*, AND *PRIONERIS SITA*

In Volume xxiv, No. 1 of the Journal, Miscellaneous Notes, xxvii, Lt.-Col. Fraser writes on ' Some Malabar Lepidoptera '.

1. Writing of *Parantirrhœa marshalli* he says : ' Its larva feeds on cane and the insect is thus rarely seen away from the neighbourhood of cane brakes.' Will he permit me to ask if ' cane ' at Lakati is the same at the ' reed ' of the Coorg Forest Department, the ' wate ' of Watakolli, which the Chief Forest Officer in Coorg told me was *Ochlandra rheedii?* There is a considerable ' reed-plot ' at Urti by the river, where *Parantirrhœa marshalli* is to be found. Also, has he found the larva ? a description of it is badly needed.

2. *Prioneris sita :* At Lakati, *Prioneris sita* was common in September ; he conjectures that it is ' single brooded and appears only during September and October.' But in Coorg it is certainly present on the Ghats at the end of December and can be had every month up to May, and in March it becomes plentiful.

As to its being sub-montane and disappearing as the ' Vayitri Ghat is descended ' ; this is not the case in Coorg. Both at Urti at the bottom of the Periambadi Ghat and near the bottom of the Sampaje Ghat, on the road and on the river, it was abundant in March and April.

3. Like Col. Fraser, I was often intrigued by the description of butterflies as ' rare ' or ' very rare ' in Evans' lists. It is certain that a good many butterflies described as rare, are as Col. Fraser says, ' not at all uncommon ', including those he mentions, in Coorg as on the Vayitri Ghat and probably in all similar localities from S. Kanara southwards. I suppose one explanation might be that, though not uncommon in their own area, they are rare if all India is considered. Another Papilio, *P. crino* is given as ' not rare ', and I believe on the Nilgiris it is fairly common, but in Coorg it is rare, if not very rare. This is a case of the opposite type. Of the Appias, *A. albina*, *A. wardi*, *A. libythea*, *A. shiva* are all noted as rare ; but *A. albina* is legion in Coorg and extends to Bangalore, and *A. wardi* fairly common on the Ghats, and *A. shiva* at its seasons abundant. Among the Lycænidæ, *Spindasis lohita* is common in Coorg ; *Apharitis lilacina* very uncommon ; *Amblypodia bazaloides* very rare ; all are described as ' rare ' which, I take it, represents the average distribution in many localities from which reports have come.

The ideal note in lists of butterflies would, I think, go more into detail regarding localities and apportion frequency or rarity of a particular insect to each locality. But this would probably mean too great space in printing. The trouble is that the books give *S. India* for the habitat of a butterfly ; but *S. India* is a large area with many varieties of climate, and the novice at any rate is misled.

BERKHAMSTEAD, J. A. YATES.
May 27, 1930.

XXV.—NOTES ON *APPIAS LIBYTHEA LIBYTHEA* ♀

On page 228 of Vol. xxxii of the Journal, Lt.-Col. Macpherson drew attention to the fact that the normal extreme dry season form of *Appias libythea* ♀ has a reddish abdomen. I note that in the dry jungles round Bangalore, any ♀ of this butterfly caught in any month in which it occurs has this reddish abdomen. I have specimens taken in different months from July to February; no two specimens are quite alike in the wing markings. They range from what is figured in the books as W.S.F. to one in which the *hw* is pure white except for faint traces of black at the end of the veins, and on the *fw* of which the upper half only of the cell and the costa, not quite to the end of the cell, are black, the cell is not joined to the dark margin and the dark margin is much reduced and barely reaches the dorsum as a narrow thread; this pale form is, I presume, the extreme D.S.F. In all seasonal phases of the ♀ however the abdomen is reddish. From W.S.F. to extreme D.S.F. often it is almost orange and is visible when the insect is in flight. Is this reddish abdomen a characteristic of dry areas, persisting even when the local relatively wet season is on and when the insect has the other wet season marks?

BERKHAMSTEAD,
ENGLAND,
May 26, 1930.

J. A. YATES.

XXVI.—ON THE PECULIAR CROSS-VEIN-LIKE STRUCTURES IN THE HIND-WINGS OF *CROCE FILIPENNIS* WESTW., ♂ (*NEMOPTERIDÆ*)

Read at the seventeenth annual meeting of the Indian Science Congress.

(With three Micro-photographs.)

In the year 1929, while studying the morphology and bionomics of *Croce filipennis* Westw., I was attracted by the peculiar mode of flight of the insect. In general, the flight consists of a series of up and down looping movements and these movements are apparently facilitated by the rapidly vibrating filamentous posterior wings.

During the same year, some more specimens were collected and brought to the Entomological Section of the Kala-azar Research Laboratory at the Calcutta School of Tropical Medicine and Hygiene, where I was carrying out investigations in my spare time, and a close examination of the structure of the filamentous hind-wings of the insect was made. A number of stained and cleared balsam mounts of the unfolded hind-wings of examples of both sexes were prepared and on microscopic examinations of these mounts, a series of parallel structures apparently of the nature of cross-veins were found in the hind-wings of males.[1] These structures are distributed throughout the entire laminated area which

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[1] Comstock (1918) describes and figures cross-veins in the hind-wings of Nemopteridæ. He fails, however, to note either the sexual differences in the structures of the hind-wings or the spiral structure of the cross-veins.

Peculiar Cross-vein-like Structure in the Hindwings of *Croce filipennis*.

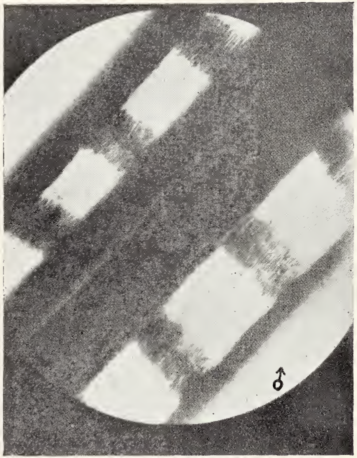

Fig. 1. Hindwing of *Croce filipennis*, ♂ showing coalesced longitudinal vein running through centre of wing. Microphotograph of a series of spirals × 20.

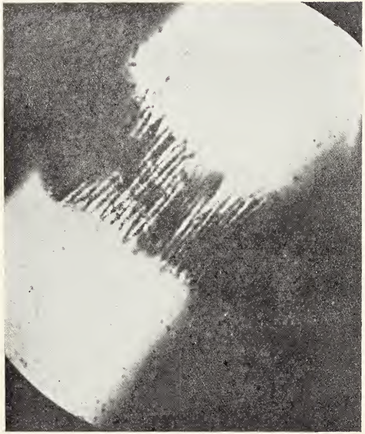

Fig. 2. Individual cross-vein under high-power microscope. Microphotograph of a single spiral × 500.

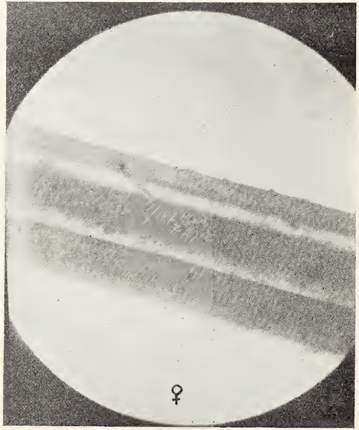

Fig. 3. Non-laminated hindwing of *Croce filipennis* ♀ devoid of cross-veins × 200.

occupies the basal one-third of the wing-length. In an individual wing, there are about 58 pairs of such structures and these are all found to run antero-posteriorly joining the proximal and distal margins of the wing. The coalesced longitudinal vein (formed by the closely approximated stems of R and M) runs through the centre of the wing (Fig. 1), and it is along this that the usual folding of the wing membrane takes place. Distally, the thickness of the laminated portion of the wing becomes reduced and along with this a reduction in the size and number of the cross-veins is visible. The cross-veins also lose their spiral structure at this region of the wing. An examination of an individual cross-vein, under a high power of microscope, reveals a spiral frame-work which is conspicuous in being of a flattened character (Fig. 2). The length of a cross-vein is 0·10 mm., while its thickness 0·04 mm. At first I took these spiral structures to be remnants of wing tracheæ. Later on, however, I came across a short note on a similar subject by Forbes (1924) wherein he mentions that in the case of Adephaga (Coleoptera) an examination of the hind-wing shows that the tough nature of the outer part of the wing in the flying position is entirely due to the curiously constructed costal margin (formed by fused C., Sc., and R). This coalesced vein is, in Forbes' opinion, rather more like a flat ribbon-like structure than a normal vein and it is also ribbed transversely on its front edge so that it bends with ease antero-posteriorly while being capable of resisting vertical pressure. Forbes, however, fails to mention whether this appearance is due to a continuous spiral or to transverse bars. If Forbes' theory be applied to the case of the hind-wings of *Croce filipennis* Westw., it would be natural for the costal margin as well as the fused longitudinal vein to be ribbed and thus be strengthened; but this is not so in the case under consideration. Prof. Johannsen of Cornell University, Ithaca, in a letter to me mentions that the structure in question closely resembles that which is present in the hind-wings of Carabidæ (Coleoptera) at the point where a fold crosses a vein. Johannsen's explanation, though quite relevant in the case of the Carabidæ, does not seem to fit in here, as, so far as my knowledge goes, the folding of the hind-wing in specimens of both the sexes of *C. filipennis* is a longitudinal one along the course of the coalesced longitudinal vein, and never across any vein. Lastly, what strikes me most is that examinations of a large number of balsam mounts of the hind-wings of males and females, reveal the presence of these structures only in the males. The hind-wings of a female, (Fig. 3) though narrower are nearly of the same length when compared with those of a male and being non-laminated, are devoid of well-defined cross-veins and are almost of equal thickness throughout their entire length. It appears to me that besides allowing a sufficient amount of resilency to the laminated area of the wing membrane of the hind-wing of a male to counteract the vertical pressure of a constantly vibrating column of air (due to the vibratile nature of the filamentous wings), these structures are probably special accessory modifications of the wings of a male to enable it to perform the function of flight more efficiently than in the case of the opposite sex, and are thus of the nature of a secondary sexual character.

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SCHOOL OF TROPICAL MEDICINE
AND HYGIENE, KALA-AZAR RESEARCH
LABORATORY, CALCUTTA,
May, 1930.

S. MUKERJI,
M. Sc., Entomologist.

(The author wishes to express herein his indebtedness to Dr. A. D. Imms, M.A., D.Sc., F. R. S., Chief Entomologist, Rothamsted Experimental Station, for the trouble he took in going through the paper and expressing his valuable opinion on the subject.)

XXVII.—BUTTERFLY COLLECTING GROUNDS AT MUSSOOREE (U. P.)

In this article I propose giving a description of the different collecting grounds for butterflies in the vicinity of Mussooree. To those collectors, who are strangers to this hill-station and who perhaps can only get up for a short holiday, to know where to collect, without wasting their time in knocking around on the chance of picking up a few specimens, this should prove useful. The best period for collecting is from the beginning of May to the time the rains come on, about 15th June. It is during this dry spell that butterflies are attracted by the moisture in the mountain streams and great numbers fly down daily to the pools or damp sand. There are six collecting grounds which I describe below in their order of merit, taking the Library as the starting point :—

(i) *The Electric Pumping Station, 5484′*

There are two routes to this place.

(*a*) Take the road to the north of the Library and continue on it till the Happy Valley gate is reached, from here get on to Dick Road to the left which will bring you to the Municipal gardens, continue along this road and you will pass close to a house called Kandi Lodge and a little way further on you will arrive at Mackinnon's Brewery. Now get on to Pump House Road to the right, or north, and carry on till the pumping station is reached. Having arrived at the iron bridge, which spans the stream, don't cross the bridge, but scramble down below it till you are under the pumping station. Here you will find some small pools and patches of moist sand, caused by the overflow from the reservoir, and settled around these pools and on the moist sand will be hundreds of butterflies of various species, while there will also be a continuous stream of fresh arrivals. It would be as well to explore the stream for some 300 yards further down, as numerous specimens are to be found there also. The distance from the Library is about 5 miles.

(*b*) Take the road to south of the Library, named Maddock Road which will lead you up to the Convent Gate, now get on to the Park Road till you meet the Brewery Road on the right which will lead you on to the Pump House Road. This route is shorter of the two by about 1½ miles. The collector should make an early start so as to be on the ground by 9 a.m. and should stop there till 2 p.m. In my collecting trips throughout India, Burma and the Andaman Islands, I have come across places where butterflies were to be seen in large numbers, but these could not approach the multitudes that visit the pumping station.

So great are the numbers and so intent are they on sucking up the moisture that many get drowned, while others get trodden under foot, as one moves about selecting the desired specimens. I give below a list of species which a collector may expect to see after the 1st of June :—

Danaidæ

Danais agleoides. M.
,, tytia. Gray.
,, limniace. Cr.
,, septentrionis. But.
,, plexippus. L.
,, chrysippus. L.
Euploea core. Cr.

Satyridæ

Pararge schakra. Koll.
Erebia annada. M.
,, hyagriva M.
,, scanda. Koll.
Ypthima sakra. M.
Melanitis leda ismene. Cr.
Lethe dyrta. Fd.
,, insana. Koll.
,, confusa. Auir :
,, verma. Koll.
,, pulaha. M.
,, vaivarta. Doh.
,, yama. M.
Mycalesis perseus. Fab.
,, nicotia. Hew.

Nymphalidæ

Eulepis athamas, Drury.
Apatura ambica. Koll.
Sephisa dichroa. Koll.
Dichorragia nesimachus. Bdv :
Stibochiana nicea. Gray.
Euthalia patala. Koll.
,, lubentina. Cr :
,, garuda. M.
Auzakia danava. M.
Pantoporia selenophora. Koll.
,, opalina. Koll.
,, perius. L.
,, asura. M.
Neptis astola M.
,, soma. M.
,, yerburyi. But.
,, mahendra. M.
,, sankara. Koll.
,, narayana. M.
,, zaida. Db.
,, ananta. M.
Cyrestis thyodamas. Bdv :
Junonia iphita. Cr.
,, lemonias. L.
,, hierta. Fab.
,, orithya. L.
Vanessa cardui. L.
,, cashmirensis. Koll.
,, c-album cognata. M.
,, canace. Joh.
Hypolimnas bolina. L.
,, misippus. L.
Kallima inachus. Bdl.
Issoria sinha. Koll.
Atella phalanta. Drury.

Argynnis hyperbius. Joh.
,, childreni sakontala. Koll.
Ergolis merione. Cr.
Pseudergolis wedah. Koll.

Libythæinæ

Libythea celtis lepita. M.
,, myrrha rama. M.
Dodona durga Koll.
,, dipœa. Hew.
,, eugenes. Bates.
,, egeon. Db.
,, ouida. M.
Zemeros flegyas. Cr.
Abisara fylla. Db.
,, echerius. Stoll.

Papilionidæ

Papilio agestor govindra. M.
,, clytia dissimilis. L.
,, machaon asiatica. Men.
,, demoleus. L.
,, polytes romulus. Cr.
,, protenor. Cr.
,, polyctor. Koll.
,, eurous cashmirensis. Roth.
,, cloanthus. Wd.
,, sarpedon. L.

Pieridæ

Leptosia xiphia. Fab.
Delias eucharis. Drury.
,, belladonna. Fab.
,, sanaca. M.
Anapheis mesentina. Cr.
Aporia soracta. M.
,, agathon phryxe. Gray.
Pieris brassicæ. L.
,, canidia, Sparr ?
Gonepteryx rhamni nepalensis. Dh.
Catopsilia pyranthe. L.
Colias fieldii edusina. But.
Terias hecabe. L.

Lycænidæ

Cyaniris albocærulea. M.
,, puspa. Hew.
Cyaniris argiolus cœlestina. Koll.
,, huegeli. M.
Chilades laius. Cr.
Catachrysops strabo. Fab.
Castalius rosimon. Fab.
Polyommatus boeticus. L.
Curetis bulis. Db.
Zephyrus ataxus. Db.
,, birupa. M.
,, syla. Koll.
,, icana. M.
Chætoprocta odata. Hew.
Euaspa milionia. Hew.
Ilerda sena. Koll.
Aphnæus vulcanus Fab.
,, ictis nepalicus. M.
Iraota timoleon. Stoll.
Surendra quercetorum. M.
Arhopala centaurus. Fab.
,, rama. Koll.
,, dodonea. M.
,, ganesa. M.
,, atrax. Hew.
Deudoryx epijarbas. M.
Hysudra selira. M.
Virachola isocrates. Fab.
,, perse. Hew.
Rapala nissa. Koll.
,, schistacea. M.
,, melampus. Cr.
Tajuria diœus. Hew.
,, illurgis. Hew.
Loxura atymnus Cr.
Horaga onyx. M.

Hesperidæ

Achalarus bifasciatus casyapa M.
Celænorrhinus pulomaya. M.
,, leucocera. Koll.
Tagiades atticus. Fab.
Coladenia indrani. M.
Darpa hanria. M.
Suastus gremius. Fab.
Pedestes masuriensis. M.
Hyarotis adrastus. Cr.
Notocrypta feisthamelii. Koll.
Udaspes folus. Cr.
Augiades brahma. M.
Ismene ataphus. Wat:
Rhopalocampta benjaminii, Guer,

(ii) *The Mossy Falls, 5,500′*

The Arnigādh (stream) which rises in Landour and runs along the foot of the ridge called Pari Tibba (Burnet Hill, local), passes close to the Tivoli gardens, the falls occurring about ¼ mile lower down. The road to it is along the Mall as far as the Picture Palace, then the Rajpore road to about ½ mile above Barlowganj to the gate of the house named Ralston Cottage. From here take the road to the left which will take you down to the stream. This is quite a good place, and the collector would do well to explore the upper reaches of the stream for about a mile or so. Distance about 3 miles.

(iii) *The Pumping Station and Dhobi Ghat at the Bhilaru Spring, 5,700′*

Along the Mall for a short distance, pass through the gorge on to the Camel's Back road and, about 150 yards from the gorge, take the path to the left, between the house named Petersfield and the Municipal Market. Keep to this path and you will get to the spring. Distance about one mile.

(iv) *The Stream below the Rifle Range, 6,000′*

As the Rifle Range is so well known, it is of little use describing the route to it. The stream is about 200 yards below the range and runs parallel with it. There is a good road down to the stream and it is distant about ¼ mile from the Mall.

(v) *The Spring on the Eastern Slope of Vincents Hill, 6,500′*

Take the road to south of Library, called Maddock Road, till you get to a spot below the Savoy Hotel; now take the road to left, called Spring Road and continue on it till the spring is reached. This is a fair collecting ground and an hour or two spent there would well repay one, besides being the easiest to get at.

(vi) *The Spring and Dhobi Ghat, East of the Kincraig Estate, 5,600′*

Take the old cart road to Rajpore and about a furlong beyond the gate of Kincraig, a stream will be met. Follow this down and you will arrive at the spring. This is a good ground for *Papilio polyctor*.

During the rains little collecting can be done, but from about middle of September to middle of November, the collecting is quite good. About this time there appears to be a general migration to the south from the Khuds (valleys) to the north of Mussooree and the butterflies make for the saddles in the main ridge in order to cross it. There are three such, taking them from west to east.

(*a*) The flat at the gate of the Convent.

(*b*) The flat at the gorge, through which the road round Camel's Back passes.

(*c*) The junction of the lane, which passes by the Telegraph Office, with the Camel's Back Road.—The last named is the best and some good catching can be done, between 10 a.m. and 2 p.m. on bright days. Collecting at this time of the year is rather strenuous work, as all the specimens have to be taken on the wing, and it needs a certain amount of skill, as every butterfly appears to be in a hurry and flies at the limit of its speed. There are certain species that are very local and are found only in particular areas and for a limited time, viz. :—

(1) *Erebia hyagriva. M.*

This butterfly can be found in large numbers on a grassy ridge called locally Patranikidhar. This ridge is in the Tehri State about 3 miles beyond the Toll Bar, on the road to Jalki. The spur is to the south of the road and runs down to Patrani village, some 500 feet below. E. hyagriva appears here in large numbers from 14th August and flies for about a month and appears to prefer dull weather.

(2) *Parage moorei. Bat.*

Fairly plentiful on the road to Woodstock School about middle September and is partial to mule droppings, flies for about 20 days.

Aulocera padma. Koll.

Found in fair numbers on the top of Landour, to the north, on Circular Road, 7,400′, where the road passes between the two Cemeteries. It flies in company with Aulocera Swaha. Koll and Saraswati. Koll during September and October.

Dilipa morgiana. Wd.

Found on the crest of Pari Tibba (Burnt Hill), 6,400′, flying in company with Sepisha dichroa. Koll from which species it is difficult to distinguish it. Males are plentiful, but the female is seldom seen. A narrow track leads up to the crest from about ¼ mile above the Massy Falls. This species is also found at Oak Grove Boys' School, 5,100′.

MUSSOOREE,
August 14, 1929.

O. C. OLLENBACH.

XXVIII.—ON THE TRUE NATURE OF THE NUCLEAR DIVISIONS IN OLD INTERNODES OF LOCAL *TRADESCANTIA* STEMS.

(*With a plate.*)

Strasburger reported amitosis in old internodes of *Tradescantia* stems, he figured a lobed nucleus in support of it. So far as higher organisms are concerned, Sharp has recorded that amitosis occurs in comparatively few well-authenticated cases. Constricted or irregularly lobed nuclei were in the past freely taken as evidences of amitosis. Goldstein in his recent investigations on nuclear form (*Bot. Gazette*, vol. lxxxvi, No. 4, Dec. 1928), states that ' the constricted nucleus appears more or less as if it were dividing.

NUCLEAR DIVISION IN OLD INTERNODES OF *Tradescantia* STEMS.

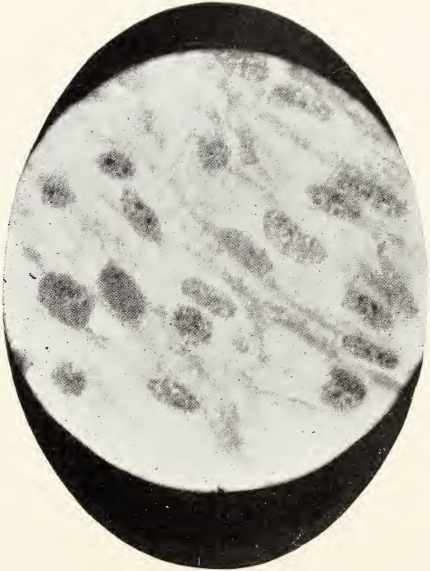

Fig. 1. Microphotograph of a longitudinal section of the stem of *Tradescantia discolor* showing elongated nuclei.

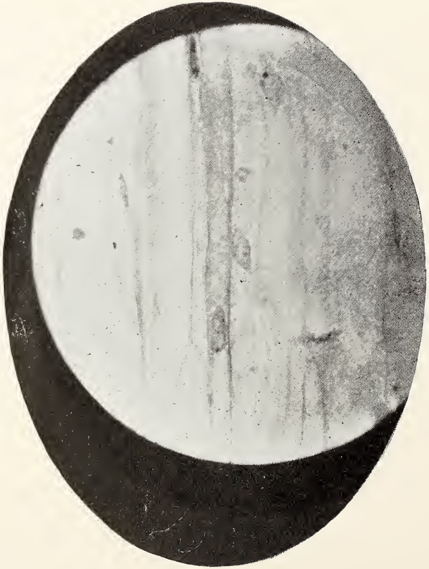

Fig. 2. Microphotograph of a longitudinal section of *Tradescantia zebrina* showing pointed nuclei.

Such nuclei occur in the parenchyma-cells of healthy green *lily* leaves and petioles, and are not an indication of amitosis . . . . Such hypertrophied nuclei with cleft, crenate, or furrowed membranes, or lobed, lobulate or amœboid outlines occur normally in healthy plants in special organs of nutrition, and associated with certain phases of nutritional and secretory acitivity.' Amitosis as a normal phenomenon in healthy cells is to be differentiated from deranged mitosis occurring in abnormal tissue due to the pathological condition of the cells, in the latter condition the nuclei usually fragment and perish in the end.

To find out the true nature of the nuclear divisions, microtome sections of the longitudinal strips of old internodes from stems of *Tradescantia discolor* (Fig. 1) and *Tradescantia zebrina* (Fig. 2) were prepared, the sections revealed a number of elongated nuclei, some ridged or irregular in outline, and a few were constricted almost like the one figured by Strasburger, they were usually one in each cell. Nowhere could I find the actual breaking up of the nuclear body into two or more rounded segments. Such elongated nuclei I could get in the cells of the ovarian wall of very young flower buds of *Polyanthus tuberosa* and of *Tirdax procumbens.*

This condition is surely not an indication of amitosis, it is connected with the metabolic activity of the cells as has been remarked by Goldstein. In *Tradescantia virginiana* stem Mons. Conard has recently worked on *mitosis* on the lobed nuclei (*Mem. Acad. Roy. Belgique*, vol. ix, 1928), he also considers that the constant occurrence of such irregular and fragmented nuclei in *Tradescantia* is connected with the vigour of the stems.

S. R. BOSE,
Professor of Botany.

CARMICHAEL MEDICAL
COLLEGE, CALCUTTA,
April 1930.

XXIX.—ON THE OCCURRENCE OF VEGETATIVE BUDS ON THE ROOT OF GRAM

(*With a text figure.*)

The occurrence of vegetative buds on the roots of plants is rather a rare phenomenon. It is, however, known in the case of the Milkweed * and a few other plants.

While doing root-washing of gram plants during the month of March, this year, small pin-head-like bodies were found to be studded on the primary roots. Superficially these bodies offered a close resemblance to the nodules—so very commonly met with among the leguminous plants—and for a long time these were actually passed for the same, because it was quite natural to expect them in a member belonging to the family *Leguminosæ.* The identity of these buds were, however, revealed, when in a few cases tiny shoots bearing compound vegetative leaves (see text figure) were observed on the roots situated in the same position as the pin-head-buds. When dissected out, these buds showed the presence of miniature compound leaves with very minute pinnæ, all covered thickly with woolly hairs. All these buds were found to be borne in the axil of scale-like structure (see text figure at *s*) which possibly has a protective function.

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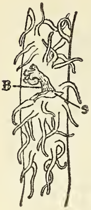
* Gerhadt, Fisk (1929) : Propagation and Food Translocation in the Common Milkweed. *Jour. Agri. Research*, Vol. xxxix, No. 11, p. 839.



The lateral (secondary) roots were found to be growing quite normally all round, on the primary root. But, one thing was quite clear and significant, namely, that the density of growth in a number of the secondary roots, was not so great in the region where the vegetative pin-head-buds were formed. These buds were found about five inches below the level of the earth's surface. They were colourless being totally devoid of chlorophyll.

It is very difficult—under the present condition of our knowledge—to foretell the rôle of these buds in the ontogeny of the gram plant. The author hopes to make a careful study on this point next season.

T. C. N. SINGH.

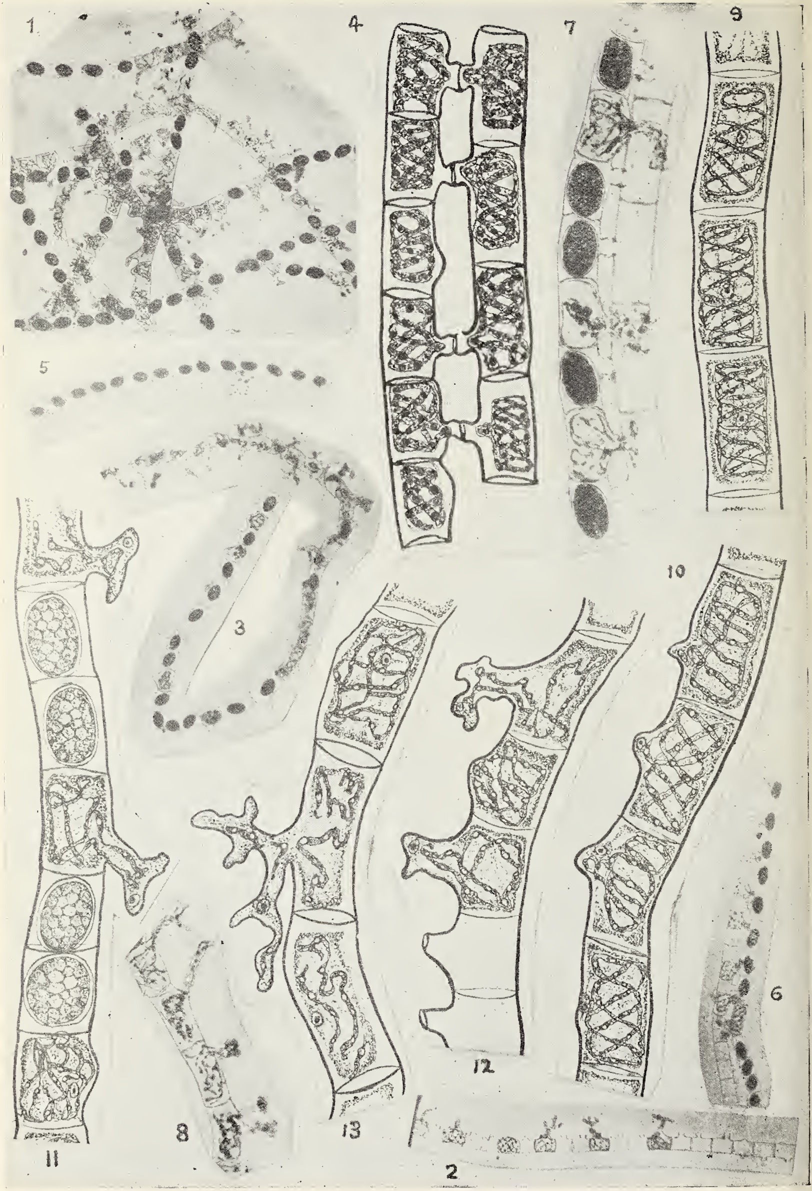
GOHUAN (BIHAR),
June 2, 1930.

XXX.—AN INSTANCE OF ANOMALOUS BRANCHING OF THE CONJUGATION-TUBES OF AN INDIAN FORM OF *SPIROGYRA NEGLECTA* (HASS) KUETZ.

While examining some of the bottles containing algal specimens in the Laboratory I found in one of them an interesting specimen of *Spirogyra* which has been identified as a form of *Spirogyra neglecta* (Hass.) Kuetz. Before proceeding to discuss the abnormalities of the conjugation-tubes I give below a description of the specimen :—

Plant-mass crowded, densely interwoven ; filaments long, flexuous, about 60–64 μ wide ; cells variable in dimensions, 95–175 μ long ; pyrenoid 6–8 μ in diameter, spherical, smooth, situated lengthwise in a series, 3 in each face of the chlorophyll-band ; bands 3 in number with smooth margin, $1\frac{1}{2}$–$2\frac{1}{2}$ turns in each cell ; fruiting cells scarcely inflated ; conjugation-tubes found in both male and female cells, 20–24 μ in width ; unfused tubes forming long irregularly-branched unseptate processes, sometimes nucleus migrating into these tubes either midway or to the apex, very rarely, a cell giving out two such tubes from the same lateral side ; Zygospores oval, prolate ellipsoid, 60–75 μ in length, 45 μ in breadth, spherical in top view, cell walls smooth.

Hab.—Floating in a tank in the suburb of Calcutta, collected by Mukshood Ali on August 26, 1924.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Branching of Conjugation tubes of an Indian form of *Spirogyra neglecta* (Hass.) Kuetz.

For explanation see end of note.

Geo. Distribution.—Great Britain, France, Belgium, Bohemia, America and Burma.

The branched conjugation-tubes noted above develop as simple inflations of the lateral sides of either a male or a female cell. These inflations gradually grow out into narrow cylindrical tubes extending in various fantastical processes. Sometimes some of these tubes look like 'haptera'. The nature of branching is rather dichotomous or trichotomous but not infrequently quite irregular. These processes are often also straight or curved and not uncommonly curling back, reversely or inversely, reminding one of the tentacles of some of the animals of the animal kingdom. These irregular developments of the conjugation-tubes of this Indian form of *Spirogyra neglecta* have been observed either on one, or rarely, on both the lateral sides of only those cells, male or female, which have failed to find out their partners in conjugation.

The structure of these abnormal conjugation-tubes does not appear to be like that of the 'rhizoids' or organs of attachment already reported by previous workers. These workers have recorded that often there are extra processes mostly developing from the dorsal sides of the *vegetative* cells as distinctly separate organs of attachment. Delf has reported the presence of regular rhizoidal organs of attachment in *Spirogyra adnata*. Iyengar has discussed and figured some organs of attachment in *Spirogyra* sp. *Zygnema* sp. and *Mougeotia* sp. He thinks that these organs of attachment, observed by him, have developed as a result of 'tactile stimulation'. West and Borge mention that in spirogyra, these rhizoid-like-branching of the conjugation-tubes may develop from cells 'some distance removed from those cells actually engaged in conjugation.' Fritsch and others too have reported the presence of organs of attachment in *Zygnemaceæ*. Pascher has also discussed about these rhizoid-like structures in *Zygnemaceæ* which serve the purpose of fastening the plants to the sub-strata when they occur in a rapidly flowing water or meet with unfavourable conditions, and considers them as abnormal developments.

West has suggested that 'in other cases, such as the replacement of a conjugation-tube by a branched rhizoid, the stimulus is obviously of another kind'. In the present case the morphological and cytological nature of the conjugating-cells and tubes are unlike those of the rhizoidal organs described by previous workers. The disorganization of the protoplasm and frequent migration of the nuclei in the conjugation-tubes along with the protoplasm evidently suggest that the stimulus is due to the physiological changes during conjugation. Apparently there is a general stimulus present due to metabolic changes when conjugation is about to take place; and all the cells, male and female, as a result of this stimulus put forth conjugation-tubes. And when for some reason or other, the partners in conjugation are not available, there is a prolongation of the conjugation-tube in all directions, giving rise to these fantastical processes, as if in an attempt at seeking a partner. But as I have only preserved material, it has not been possible for me to carry on physiological experiments to prove my hypothesis. I therefore simply record this case for future work.

In conclusion I must acknowledge my deep debt of obligation to Mr. K. P. Biswas, M.A., Curator, Herbarium, Royal Botanic Garden, Calcutta, for his generous and helpful advice and criticism, and also for the many facilities he has afforded me in preparing this thesis.

Description of figures in Plate.

Figs. 1 to 3 and 5 to 8 are microphotographs, and the rest are camera lucida drawings.

Fig. 1. General view of the spirogyra filaments showing the anomalous growth of conjugation-tubes. × 50.
,, 2. A male filament showing empty cells and cells with branched conjugation-tubes. × 50.
,, 3. A female filament showing zygospores and branched conjugation-tubes developed from one or both the sides of the cells which have failed to conjugate. × 50.
,, 4. Normal nature of a part of a conjugating filament. × 150.
,, 5. A pair of conjugating filaments showing two unpaired male cells. × 50.
,, 6. Same as in figure 5 but showing unpaired male cells alternating with paired ones. × 50.
,, 7. Part of a pair of conjugating filaments magnified to show the origin and structure of these abnormal conjugation-tubes. × 120.
,, 8. A filament showing two conjugation-tubes arising from a cell. × 70.
,, 9. A normal filament. × 200.
,, 10. A filament showing initiation of formation of the tubes. × 200.
,, 11. A female filament showing migration of the nucleus in the branched conjugation-tube. × 200.
,, 12. The same as in Fig. 11 in a male filament. × 200.
,, 13. A much-branched conjugation-tube showing migration of the nucleus and protoplasmic contents. × 200.

15, Crouch Lane
P. O. Bowbazar,
Calcutta.

KANTI GOPAL BANERJEE.

XXXI.—SOME LIVERWORTS OF THE ORDER *MARCHANTIALES* FROM BURMA

The present note records *Marchantiales* collected from Rangoon (1927–1929), Maymyo (Oct. 1928) and Kalaw (April to May 1929). The rainfall in all these places is limited to the months of May to October, the plants thus passing through a dry period in the intervening months.

Practically all these species have already been described from India by Kashyap (1929) therefore only their names with references are given. In all, 8 genera and 13 species have been observed.

The classification followed in this note is that of Goebel (1910), the course of evolution being considered to be in the direction of simplification.

ORDER: MARCHANTIALES.

FAMILY: MARCHANTIACEÆ.

GENUS: Marchantia. Linn. 1753.

M. polymorpha Linn. 1753; Pearson 1902, 466; Cooke 1907, 267; Pascher 1914, 182; Macvicar 1926, 46; Kashyap 1929, 32. Habit.—Botanical Garden Maymyo and Taunggyi.

M. palamata Nees. 1824; Kashyap 1929, 34. Habit. Moist rock near Taunggyi, stream-banks in Kalaw, Maymyo and Goktiek Gaze (Cochrane).

Abnormalities of the female receptacles common, have previously been described. (Khanna 1930.)

GENUS: Dumortiera Reinw. BL. ET NEES. 1824.

D. hirsuta (Sw) Reinw. Bl. et Nees. 1824; Pearson 1902, 274; Macvicar 1926, 42; Kashyap 1929, 42.

Habit. Under running water and mouths of waterfalls; Botanical Garden, Maymyo.

GENUS: Cyathodium Kunze 1854.

C. cavernarum Kunze 1854; Lang 1905, 411; Khanna 1927, 227.

Habit. Shady places and near water, Rangoon; Mergui (Ghose); Maymyo and Kalaw.

C. kashyapii Khanna 1929, Khanna 1929, 118.

Habit. Rangoon moist places and banks of waters. Maymyo Golf course.

GENUS: Targionia Linn. 1753.

T. hypophylla Linn. 1753; Pearson 1902, 480; Cooke 1907, 277; Macvicar 1926, 33; Kashyap 1926, 57.

Habit. Maymyo, Kalaw, Taunggyi and Gokteik Gaze (Cochrane). The specimens showed a marked variation in size and colour. The differences were due to varied environments. Plants from moist places were green and measured 13–20 mm. long and 3–5 mm. broad, while those of dry and exposed places were dark green and between 10–15 mm. long and 2–3 mm. broad.

GENUS: Fimbriaria. Nees. 1820.

F. angusta St. 1899; Kashyap 1929, 63.

Habit. Very common in Maymyo along the Golf course and roadsides. There are three more species of *Fimbriaria*, but these could not be determined as the material was young.

GENUS: Reboulia Raddi 1818.

R. hemispherica (Linn) Raddi 1818; Pearson 1902, 470; Cooke 1907, 272; Macvicar 1926, 36; Kashyap 1929, 72.

Habit. Moist rocks Taunggyi and Kalaw.

GENUS: Plagiochasma L. etl. 1832.

P. articulatum Kashyap 1914; Kashyap 1929, 75.

Habit. Rocks Kalaw, Mamyo and Taunggyi.

P. appendiculatium Let L. 1832; Kashyap 1929, 76.

Habit. The same as above.

FAMILY: RICCIACEÆ.

GENUS: Riccia Linn. 1753.

R. himālaynesis St. (Ms) 1916; Kashyap 1929, 93.

Habit. Very common on moist soils; Kalaw, Maymyo and Rangoon.

R. cruciata Kashyap 1916; Kashyap 1929, 95.

Habit. Kalaw and Maymyo.

R. fluitans Linn 1753; Pearson 1902, 495; Cooke 1907, 287; Pascher 1914, 181; Macvicar 1926, 28; Kashyap 1929, 97.

Habit. Floating or on mud. Maymyo and Rangoon.

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UNIVERSITY OF RANGOON, L. P. KHANNA.
March 24, 1930.

XXXII.—NOTE ON BROOMCORN WITH FIVE BRUSHES

Broomcorn is a variety of Sorghum (juar) which differs from other species in having panicles and seed-heads with much longer, straighter and stronger branches. It is known to botanists as *Andropogon sorghum*, var *technicum* and is known in Southern Europe and America. It belongs to the grass family and to the same species as do common sorghums, used for making syrup, and Kaffir corn and Jerusalem corn, grown for forage and for grain. The standard type grows to a height of 10 to 15 feet and produces a brush from 18 to 28 inches long.

In a sample of Italian broomcorn 'brush' a few seeds were discovered by accident and formed the starting point of a series of tests. The first series of tests showed that broomcorn can grow under the most varied and adverse conditions with extraordinary facility. It yielded sufficient stock of seed for field experiments on a larger scale.

The second series of field tests were also surprisingly successful. About half a maund of seed, possessed of a high degree of selectivity, and capable of rearing a very strongly resistent plant, was obtained.

This improved seed was distributed to some 25 farms in the country. In one farm[1] at Allahabad the plants have done very well and produced a most abnormal type with 5 brushes instead of only one. Some plants have got 3 brushes and all are heavy with corn and seed heads. One has got 6. The seeds obtained are bigger than those sown.

The greatest advantage is that birds cannot eat the corn after ripening since the brushes droop with weight. The farmer has not to watch his field.

Hundreds of parrots used to sit on these plants but none could be eaten by them. After a time the birds ceased to come.

The corn is liked by villagers who have taken to introducing it in their villages.

Broomcorn can be put to numerous uses among which are the manufacture of (1) brooms, (2) brushes of several kinds, (3) ropes, (4) chiks, (5) fans and (6) baskets, etc.

RAE BARELI, U. P., S. S. NEHRU,
March 1930. *I. C. S.*

XXXIII.—CULTIVATION OF BROOMCORN IN INDIA[2]

In the last paper at Madras, results of successful tests with broomcorn under European, African and American conditions were communicated. These tests have since been continued on a large scale in Algeria with uniformly successful results. Not only has the selectivised hardened Indian seed been found by repeated cultivation to yield the best brush, but it has been officially adopted by the Governor-General's Agricultural Institute for all future cultivation, to the suppression of all local varieties. Furthermore, extensive plantation of this Indian broomcorn is being undertaken in the region of Bona for the supply of raw material to three factories of brooms and brushes. Also, the cultivation of Indian broomcorn is now to be extended to Tunisia under the auspices of the Agricultural Institute of Sfax.

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[1] By courtesy of Mr. U. C. Mukerji, Asst. Commr. of Excise, Allahabad, U.P.

[2] Paper No. 28 read before the Indian Science Congress, Section I (Agriculture) at Allahabad on January 6, 1930, by Dr. S. S. Nehru, B.Sc., M.A., Ph.D., I.C.S.

Encouraged by the good results obtained in the various parts of the world with the Indian broomcorn seed, which have been made available to the farmer in a bulletin (No. 48) published by U. P. Government on the cultivation of broomcorn for which I am deeply indebted to our Chairman, some 26 farms in India have gone in for broomcorn culture. This selectivised seed has been distributed to 7 Government farms. 11 taluqdaris' farms and 8 private farms. The Government farms are in Muttra, Partabgarh, Rae Bareli, Poona, Gwalior, Dharwar and Sholapur. The taluqdaris' farms are mostly in the Rae Bareli district. The private farms are in Allahabad, Cawnpore, Jhansi, Lahore, etc. Thus tests are being made in representative parts of the country.

Results to date are satisfactory on the whole although all the farms have not yet reported. The Government farms in India, as abroad, have done particularly well. The Gwalior farm (1) has raised a very healthy crop, sown on August 24, 1929, with 80 cm. long straight panicles which are suitable for good brooms, brushes, etc. As the area cropped was small, results as regards yield per acre, cost per acre, etc., are not given.

The Dharwar farm (2) has produced a fairly good crop, sown on August 17, 1929. The panicle measures 73 cm. but there is curling in some panicles at the base, which is a defect.

The Muttra farm (3) reports that seed sown on August 10, 1929, showed good germination but after one month's growth the crop was destroyed by locusts. Further tests will be made this year.

The Partabgarh farm (4) tried broomcorn for multiplication of seed only. A 1/10th acre plot was sown on June 20, 1929. The germination of the plot was very good, but growth and outturn was affected, but comparatively less than the Kharif crops by the heavy, incessant rain in July and August on the one hand, and the long break in August and September. These adverse factors notwithstanding the plants reached an average height of 10 ft. The crop was harvested in October, yields being as follows :—

Seed	1 md. 17 srs. per acre.
Stalks	55 mds. per acre.

The soil was light dumat, well-levelled but not manured. The Rae Bareli farm (19) has had good results although crops were damaged by raiding monkeys. Sown on July 13, 1929, germination on July 20, 1922 was very good. Average panicle measured 82 cm. The crop was harvested in November with the following yields :—

Seed	18 seers per acre, average height 10 feet.
Stalks	30 mds. per acre.

An intermediate fodder crop was obtained on September 9, 1929, when all the leaves were lopped and given to cattle.

Results from the remaining Government farms at Sholapur and Poona are still awaited.

The taluqdaris' farms which have not the advantage of expert guidance as the Government farms have obtained some very interesting results.

The Kachaunda farm has yielded the best brush as exhibited. It measures 91 cm. which still falls short of the record of over one meter held by Governor-General's farm in Algeria. Narekigadhi and Murarmau farms have shown that broom germinates and grows as well in poor sandy soil as in rich loam. Khajurgaon farm has had very good germination in the minimum of time, 3 days for loam and 4 for sandy soil. These farms have obtained good supply of seed for further tests.

The private farms have not all reported yet, but one deserves special notice. It has obtained from 10 plants 1/2 seer of seed grain which is bigger and better than the seed sown. Some of the plants have multiple brushes and one as many as six and when one such brush is harvested another begins to grow *in situ.*

Reviewing all results, it is clear that broomcorn cultivation in India has considerable prospects of success.

RAE BAREILY, S. S. NEHRU,
March 1930. M.A., Ph.D., I.C.S.

PROCEEDINGS

Proceedings of the Meeting held on July 24, 1930

A meeting of members of the Bombay Natural History Society and their friends was held at the Prince of Wales' Museum on Thursday, July 24, at 6 p.m., Mr. J. B. Greaves presided.

Sir Reginald Spence, the Honorary Secretary in announcing the election of 5 life members and 44 ordinary members since the last meeting, referred to the Annual Report of the Society which stressed the necessity of increasing the membership. As the Society received no direct grant from Government, its existence depended on the subscriptions received from its members. This was practically the only source of its revenue, so if its activities were to remain unimpaired, it was important that the strength of the membership should be maintained and that losses from resignations should be made good by new members joining. Even Scientific societies depended to-day on advertisement. The Society's *Journal* was its best advertisement. Members could help by making the *Journal* better known by showing it to their friends. There must be many people who have not heard of the Society who would gladly join if they knew of the advantages it has to offer.

Commenting on the recent activities of the Society, Sir Reginald Spence referred to the Vernay Scientific Expedition to the Eastern Ghats which had already produced such good results. The Expedition had greatly increased the knowledge of the distribution of birds in India and had necessitated the recasting of our ideas as regards the range and status of many species. A preliminary report of the work of the expedition has appeared in the last issue of the *Journal*.

FORTHCOMING PUBLICATIONS

Among the forthcoming publications of the Society was the third volume of *Stuart Baker's Game Birds* which deals with the pheasants. The work is being issued in the same attractive form as the two previous volumes. The book will be available in India before the cold weather.

As members were aware the Society has had for some time in preparation a series of charts illustrating about 200 Indian birds in colour.

The illustrations are arranged in 5 charts. The first of which has already been printed—the remainder are now nearing completion. The printers had sent out an advance copy of one of the charts. Members could judge for themselves from the specimen before them how useful these charts would be in helping people to recognize the common birds seen about towns and villages in the plains of India. They will be specially useful in schools and of invaluable assistance to teachers in awakening an interest among their pupils in the bird life of the country.

THE MUSEUM

Sir Reginald next referred to the Guide to the Natural History Section of the Prince of Wales' Museum prepared by Mr. Prater, the Society's Curator. The Guide showed how much had already been accomplished in the Museum. It also indicated how much more could be done for the 'public' if the plans for providing a separate wing for Natural History could materialize. Times were not very propitious for an appeal for funds. Never the less there were people who realized that the cause for which the Society was working was one which deserved support. The Museum is an institution intended for the people, for their instruction and entertainment. It was doing work for the good of the country, for national progress and culture. He was glad to be able to announce that a donation of Rs. 10,000 towards the new building had been received from His Highness the Maharao of Cutch, one of the most generous benefactors of the Society. The assistance received from His Highness was a source of encouragement to those who were working for the realization of the plans which would enable the Museum greatly to increase its utility to the public of this City.

IMPROVEMENT OF SHELL-FISHERIES

There were yet other ways in which the Society was rendering public service. It had just completed a survey of the shell-fisheries of the West Coast. The survey was carried out on the Society's behalf by Mr. H. S. Rai of the Royal Institute of Science. The work done by Mr. Rai laid special stress on the economic aspect of our shell fisheries and included the recommendation of measures for the improvement of what is an important and valuable source of food supply to people and an equally important source of revenue to the fishing community of the coastal district. Mr. Rai's report will shortly be published in the *Journal.*

PUBLIC HEALTH

Another channel of public service was the interest taken by the Society in matters which concern public health. Medical men particularly in the tropics had to turn to the naturalist for help in fighting disease. The chart for the identification of Poisonous Snakes issued by the Society was in use in practically every hospital and dispensary in India. The Society was now interested in an investigation into the venoms of Indian scorpions which was being conducted on its behalf by Rev. Father Caius. It had also helped very considerably through the medium of its Journal by the publication of important papers relative to the subject of malaria. Sir Reginald referred to the extremely valuable papers published by Col. W. Glen Liston in 1908 and by Dr. Bently in 1911. Both Liston and Bently had rendered invaluable service to the City. Their papers previous to publication had been read at meetings of the Society. He was now privileged to bring to the notice of members the work done by Major G. Covell, in helping to rid Bombay of its greatest and most insidious scourge.

THE PROBLEM OF MALARIA IN BOMBAY

In the course of his paper which is published in the present issue, Major Covell summarizes the results of a survey completed by him in 1928. A single species of mosquito transmits malaria in Bombay. This is *Anopheles stephensi*, a mosquito which breeds in wells, cisterns, fountains, garden tanks and tubs and similar collections of water, all of which are exclusively man-made. Whilst malaria in 1928 was less prevalent in the southern portions of the City than in 1911, the disease was found to have become more widely diffused. The mill area about Parel and Worli is now a hot bed of malaria. This is largely due to the northward shift of the population. The population of Worli practically doubled itself during the period under review. There has also been an enormous increase in the number of tanks and cisterns in this area, the total rising from 92 in 1911 to 5,257 in 1928. Added to this are the vast number of breeding places which have been created during the construction of reinforced concrete buildings. Major Covell believes that it would be possible to bring malaria in the Island under complete control by the adoption of a systematic campaign to eliminate all such breeding places or render them mosquito-proof. As long as these permanent breeding places exist, malaria will continue to persist in Bombay because there will always be an influx of infected human beings from outside, and periodical outbreaks of a serious nature will continue to occur whenever local conditions are favourable for the spread of the disease. There are however certain grave obstacles to the carrying out of preventive measures in Bombay. Among these may be mentioned the fact that various parts of the Island are controlled by different authorities and the lack of co-operation amongst these authorities : the religious and sentimental objections on the part of certain sections of the people to the closure of the wells ; and a deplorable tendency to drag matters affecting public health into the realm of party politics. Without the active and loyal co-operation of all concerned, success cannot be attained.

The education of the public in matters concerning their health is, in Major Covell's opinion, an equally important factor. To this end the Museum had made a contribution in the excellent cases illustrating the breeding habits and life history of the malaria mosquito. Enlarged models of the mosquito, of its eggs, larva and pupa show exactly how the mosquito develops in water and emerges eventually as the adult winged insect. The cases are labelled both in English and the vernacular to make their lesson intelligible to a wide class of people.

Proceedings of the meeting held on August 28, 1930

FISH SUPPLY OF WEST COAST

Suggestions for Inquiry

A meeting of the members of the Bombay Natural History Society was held at the Prince of Wales' Museum on Thursday evening, August 28, Mr. H. A. W. Brent presiding. The election of the following 11 new members was announced: Mr. W. D. Pyman, Siam; Mr. A. C. Dunsdon, Lucknow; the Principal, Victoria College, Gwalior; Major W. E. Duncan, D.S.O., M.C., R.A., Naini Tal, U.P.; Captain H. M. Poulton, Sibi, Baluchistan; the Commandant, Zhob Militia, Fort Sandeman; Mr. A. A. F. Minchin, I.F.S., Bellary; Mr. E. M. Crothers, I.F.S., Chittoor, Madras; Mr. A. St. Alban Smith, Singapore; H. H. the Nawab of Bhopal, Captain L. Bootle-Wilbraham, Madras.

Illness prevented Sir Reginald Spence from reading his paper on the Fish Supply of the West Coast. In his absence the paper was read by Mr. S. H. Prater, the Society's Curator.

The paper dealt with the principal food fishes taken by the trawler 'William Carrik' and includes the more important fishes which form the basis of the fishing industry in the local creeks and estuaries and concludes with a summary of present-day marketing conditions in Bombay. The catches made by trawling in local waters included ten important species. These were Ghole (*Sciaena*) and three species of Rawas (*Polynemus*), all of which figure on Bombay menus as 'Indian Salmon.' Although they bear no relation whatsoever to the salmon of northern waters, they are all excellent food fish. Next come the Pomfrets, perhaps the best known fish in Bombay. Two species are common locally, the white Pomfret (*Stromateus cinereus*) and the black Pomfret (*S. niger*). Not very well known in our city is a perch-like fish, the 'Karel' (*Pristipoma maculatum*), an excellent table fish which, if better known, would certainly find favour among the consumers of the best kinds of fish in Bombay. One sometimes sees a bright cherry red fish carried on the heads of fish-wives through our streets. This is the 'Tamb' (*Lutianus*) Tell your cook about it.

The 'Tamb' is one of our prime food fishes. Cat fishes figured largely in the catches made by the trawler. In Bombay they are generally classed under the name *Singhala*. They are fish which enter largely into the dietary of the poor. The same may be said of the Eels and Eel-Pikes known in our market as 'Wam.' Slighter in build but akin to the 'Bombay Salmon' in flavour is a fish called the 'Dori' (*Sciænoides brunneus*). It is a common fish in the Bombay market in the cold weather. The Moon Fish or 'Chand' (*Drepane punctata*) a gleaming silvery fish, as flat as a pomfret is an excellent table fish. A large 'Chand' is about a foot long and weighs nearly 3 lbs.

Skates and Rays were the undoing of the 'William Carrick.' She took 50,000 lbs. of them and realized Rs. 311 for the lot. There is little demand for them in Bombay. Yet Rays command a good market in England. Excellent as food, they are more nutritious and digestible than many other prime fish obtainable here. The same might be said of some of the sharks. A Mediterranean species has been proved to be of higher nutritive value than Salmon, Plaice or Sole.

These are among the principal fishes available in the vicinity of Bombay by trawling or bottom fishing, but there are a number of imoprtant food fishes of excellent quality, which are poorly or not represented at all in the catches made by the trawler. Most of these are in shore fishes. The 'Palu' (*Chrysophrys berda*) is held in high esteem by all who know its edible qualities, In Madras people call it the Black Rock Cod, but the Black Sea Bream would be a better and truer name of it on the menu. ' Surmai' (*Cybium*) are well known and esteemed in Bombay fish markets. They salt and dry well. One of them (we have three common species) forms the basis of that pungent decoction known as ' Tamarind Fish.' Akin to the Surmai are two species of ' Karli ' (*Chorinemus*) fine in flavour when fresh and good for salting. About the ' Gobra ' (*Serranus*), Captain Flanders, the Superintendent of Markets, holds that it has a flavour superior to the Pomfret, which really takes a lot of beating. It is a tip worth remembering. Fishes of this genus, also known under the name ' Vekru,' are sold alive in the markets ; so are ' Newtas,' those queer amphibious fish, which live in thousands upon our mud banks, where their slippery movements can be watched after the tide has receded. The ' Vekru ' and the ' Newta ' are beloved of the Borah community who like their fish fresh and make certain of it.

Of Soles we have two good sizeable fishes. Your cook should be told to ask for ' Bhakas' if you want to sample them. They are in plenty during the cold weather. Then there are Grey Mullets. The larger species are known as ' Boi ' or ' Pilsa,' all of them are good table fish. Lady Fish, known locally as ' Murdi,' are recommended to ladies just in or just out of an ' interesting condition.' Perhaps, this is why they are called Lady Fish ! But they are just as good for their less interesting halves. The ' Cock-up ' known in the Bombay market as the ' Kajura ' is one of the migratory species, which comes up our creeks and streams to spawn. Its edible qualities are well known. We have still to mention two species, members of the Herring family ; these are ' Bing ' and Pala (*Clupea*).

These are some of the prime fishes of the Bombay markets, but it will be a surprise to many that these prime fishes are not the mainstay of the fishing industry. The well-being and prosperity of the fishing community does not depend on them. We have unfortunately no statistics available of the fish supply of the Bombay coast to give us the quantity and the values of the various species sold. In Madras they do things better. They have a Fisheries Department which, among other things it does for the fishermen, keeps annual statistics of the quantity and the values of the various species sold. This enables them to know what species are of real economic importance. One point emerging from these statistics is the startling fact and it is the despised cheap fish, Ribbon fish, Silver-bellies, small bony Horse Mackerel, various species of Sardines, which are the real mainstay of the industry.

Supply in City below demand

It is stated that the fishing industry in India would suffer scarcely a loss if all the Seer, Pomfret, Whiting and similar high-priced fish were exterminated, while the loss of any of the smaller bony fish mentioned would inflict irreparable damage to the fisheries and fishermen. In Bombay, dried ' Bombay Duck ' or ' Bombils ' and Ribbon Fish (*Trichiurus*), known locally as ' wakti ' form the principal animal food of thousands of poor people. Their advantage is that they can be dried *au naturel* without salt. Fish cured with salt is a luxury beyond their reach, and as for meat, they don't get it twice in a year. Other food fishes purchased in abundance are small Silver-bellies, Anchovies, bony Mackerel, Shrimps and Prawns.

The present fish supply of this city is much below the demand. Our local fisherman cannot cope with the city's needs which are increasing and are met by imports from our coastal ports, made possible by the establishment of facilities for cold storage in our markets. The local industry has been adversely affected in recent years by high operating charges in Bombay. Besides this the spread of education has brought about a tendency among the children of our local fishermen to give up the business of their forefathers and to seek their livelihood elsewhere than upon the waters.

The proposed survey of the fisheries of the West Coast which the Bombay Government are taking up this cold weather is looked forward to with interest. Points which might form with advantage the subject of investigation are the provision of statistics relative to the various species of marketable fish obtainable on our coasts, the quantities in which they are obtained, and values realized, the ports at which different species are abundant at different seasons of the year and times of fishing and the weight and values of fish obtained at the principal fishing centres. Equally helpful would be information as regards the nature of the fishing ground and the depths at which the more important economic fishes are taken at different ports at different seasons. Other important points would be an inquiry into the various types of nets used by local fishermen and into the destruction of fry in creeks, rivers and estuaries by the use of particular types of nets and traps. The economic condition of the fishermen and factors which may be adversely affecting the industry would naturally form an important part of the inquiry and lastly, the suggestion of measures for the utilization and development of bye-products of the industry would help materially in its development. The Society would, of course, be glad to help Government as much as possible in the inquiry.

CONTRIBUTIONS TO THE MUSEUM FROM JANUARY 1 TO SEPTEMBER 30, 1930.

MAMMALS

1 Central Asian Wild Cat (*Felis shawiana*) Skin and skull.	Kashgar	Capt. G. Sherriff.
1 Indian Wild Dog (*Cuon dukhumensis*). Skin and skull.	Nilgiris	Major Pythian-Adams.
1 Four-horned Antelope (*Tetraceros quadricornis*). Skin and skull.	(Died in captivity) ...	Supdt., Victoria Gardens.
1 Marbled Cat (*Felis marmorata*). Skin only.	Haka, Chin Hills ...	Capt. T. R. Livesey.
1 Golden Cat (*Felis temmincki*). Skin and skull.	Do. do. ...	Do.
1 Giant Squirrel (*R. gigantea*). Skin only.	Do. do. ...	Do.
1 Black-backed Squirrel (*T. lokroides*). Skin and skull.	Taungdwingyi, Burma.	Lt -Col. R. W. Burton.
1 Small Indian Civet (*V. malaccensis*). Skin and skeleton.	Do. do. ...	Do.
1 Tsaine (*B. b, burmanicus*). Skin and skeleton.	Magwe Dist., Burma...	Do.
1 Thamin ♀ (*R. thamin*) ...	Taungdwingyi, Burma.	Do.
1 White-browed Gibbon (*Hylobates hoolock*).	Do. do. ...	Do.
1 Sind Ibex (*Ch. blythi*) Mounted head.	Sind	Lt.-Col C.H. Stockley.
1 Himalayan Black Bear (*S. tibetanus*). Mounted Head.	Sham-Shibi Mts., Kashmir.	Do.
1 Himalyan Black Bear (*S. tibetanus*). Mounted Head.	Burmo-Siam Border ...	Do.
1 Panther Juv. Skin, skull and leg bones.	Kheri, U. P. ...	Do.
1 Panther (*P. pardus*) Skin, skull and leg bones.	Do. do.	Do.
1 Small Indian Civet (*V. malaccensis*) Skin and skull.	Do. do.	Do.
1 Hyaena (*H. striata*) Skull only.	Kheri, U.P. ...	Lt.-Col. C.H. Stockley.
1 Swamp Deer ♂ (*R. duvaucelli*) Skin, skull and leg bones.	Do. do.	Capt. L.D.W. Hearsey. Lt.-Col. C.H. Stockley
1 Swamp Deer ♂ (*R. duvaucelli*). Skin, skull and leg bones (*Juv*).	Do. do.	do.
1 Swamp Deer ♂ (*R. duvaucelli*). Skull only.	Do. od.	do.
1 Hog Deer ♂ (*H porcinus*) Skin, skull, and leg bones.	Do. do.	do.
1 Hog Deer ♀ (*H. porcinus*) Skin, skull and leg bones.	Do. do.	do.
1 Spotted Deer ♂ (*C. axis*) Skin, skull and leg bones.	Do. do.	do.
1 Spotted Deer ♀ (*C. axis*) Skin, skull and leg bones.	Do. do.	do.
1 Spotted Deer ♀ (*C. axis*) Skin, skull and leg bones (*Juv.*)	Do. do.	do.
1 Flying Squirrel. Skull only.	...	do.
1 Hispid Hare (*C. hispidus*) Skin and skull.	...	do.

MAMMALS—(*continued*)

1 Indian Lion (*P. l. persicus*) (Skin and skeleton).	Kathiawar. ...	Lt.-Col. A.H.E. Mosse
1 Taylor's Flying Squirrel (*Petaurista taylori*).	Tavoy, Burma ...	A.L.E. Brownlow.
1 Lesser Himalayan Flying Squirrel (*E. fimbriatus*).	Kashmir	A. E. Osmaston
1 Brown-toothed Shrew (*Soriculus caudatus*).	Tura, Garo Hills Assam	N. E. Parry.

BIRDS.

1 White Stork (*Ciconia c. ciconia*).	Victoria Gardens, Byculla.	Superintendent.
2 Black Swans	Victoria Gardens, Byculla.	do.
1 Golden Pheasant (*Chrysolophus amherstiæ*).	Victoria Gardens, Byculla.	do.
1 Monal (*Lophophorus impejanus*).	Victoria Gardens, Byculla.	do.
1 Chestnut-mantled Khoklas (*Pucrasia m. castanea*)	Chitral.	J. R. Stockley Roper.
1 Brahminy Kite (*Haliastur indus*).	Trichinopoly... ...	Fr. Leigh.
1 Mallard (*Anas platyrhyncha*).	Upper Chindwin ...	N. Terkle White.
1 Wigeon (*Mareca penelope*).	Do. ...	Do.
1 Mallard (*Anas platyrhyncha*).	Mole Stream, Bhamo.	A. J. Jones.
1 Tufted Duck (*Nyroca f. fuligula*).	Mawlaik, Burma ...	T. White.
1 Stiff-tailed Duck (*Erismatura leucocephala*).	Shahpur District ...	Lt.-Col. W. E. Fleming.
1 Baikal Teal (*Nettion formosum*).	Bankipore, Patna ...	Lt.-Col. H. Datton.
1 Garganey Teal (*Querquedula querquedula*).	Kolhapur District ...	Pri. Sec. to H.H. the Maharaja of Kolhapur.
1 Common Courser (*Cursorious coromandelicus*).	Bastar State	P. Mitchell.
1 Indian Ringed Dove (*Streptopelia decaocoto*).	Do.	Lt.-M. G. Sturm.
1 Munia (*Uroloncha striata*).	Tura, Garo Hills ...	N. E. Parry.
32 Birds	Peshawar, N. W. F. P.	Lt. B. W. Battye.
12 Drongos (*Dicrurus macrocercus*).	Calcutta	Lt.-Col. R. B. Seymour-Sewell.
7 Black Drongos (*D. Macrocercus*).	Madras	Dr. Gravely.
1 Rock Nuthatch (*Sitta n. tephronota*).	Sinjar, Baluchistan ...	Lt.-Col. C. H. Stockley.
1 Crested Black Tit (*Lophophanes rufonuchalis*).	Do. ...	Lt.-Col C. H. Stockley.
1 Wood-Snipe (*Capella nemoricola*).	Bhamo, Chinese Frontier.	P. M. R. Leonard.
49 Birds	Eastern Persia ...	Collected during Survey. Lt. Col. R. Meinertzhagen.
122 Birds	Tuna, Persia ...	C. E. Capito.
34 Birds	Chang Chang Pani, Assam.	Collected during Assam Expedition. C. McCann.

REPTILES

TURTLES.

4 Turtles (*Emyda punctata*).	Benares University ...	N. K. Tiwary.
4 Do. do. ...	Rameswaran, S.I. ...	Shanker Narayan Pillay.
7 Carapaces of (*Testudo elegans*).	Rameswaran Islands...	Shanker Narayan Pillay.
1 Turtle (*Emyda* sp.) ...	Madura, S.I. ...	Shanker Narayan Pillay.
1 Tortoise (*Geoemyda t. thermalis*).	Do. ...	Shanker Narayan Pillay.
2 Turtles (*Emyda* sp.) ...	Vellore District, North Arcot.	Assistant Inspector of Fisheries.
1 Turtle Do. ...	Madras	Director of Fisheries.
1 Do. Do. ...	Chowgat, Malabar District.	Do.
1 Do. Do. ...	Vellore, Madras ...	Do.

LIZARDS, SNAKES, Etc.

1 *Varanus bengalensis* ...	Tura, Garo Hills, Assam.	N. E. Parry.
1 *Eublepharis macularius* ...	Fort Munro, Dhera Gazi Khan, Punjab.	T. B. Creagh Coen.
2 Cobras (*Naia tripudians*)...	Abbottabad ...	Off. Com., I. M. Hospital.
2 Cobras (*Naia tripudians*)...	Do. ...	Off. Com., I. M. Hospital.
1 *Oligodon cyclurus* ...	Pamtola, Assam ...	D. Allan.
1 *Typhlops actus*	Malabar Hill ...	J. G. Ridland.
1 *Psammophis condanarus* ...	Karachi	(*Purchased alive*).
1 *Zamenis mucosus*... ...	Deolali	Station Hospital.
1 *Dipsadomorphus trigonatus*.	Jubbulpore	British Station Hospital.
1 *Tropidonotus piscator* ...	Lonavla	W. Graham.
1 *Zamenis mucosus* 1 *Oligodon arnensis* 1 *Tropidonotus stolatus*	Santa Cruz	Officer Commanding Station Hospital.
1 Common Krait (*Bungarus caeruleus*).	Andheri	F. Hearn.
1 Common Krait (*Bungarus caeruleus*).	Do.	Capt. Fitzgerald.
1 *Coluber helena*	Deolali	British Military Hospital.
1 *Trimeresurus gramineus* ...	Pachmarthi, C. P. ...	British Military Hospital.
1 *Tropidonotus baileyi* ...	Yotung, Tibet ...	PoliceOfficer, Sikkim.

INSECTS, Etc.

63 Butterflies. ... ... 1 Papilio machaon ... 2 Aporia lucodice ...	Bostan Terek, 60 to 70 m. of Khasghar.	Capt. G. Sherriff.
Samples of teak showing injury done by *D. ceramicus*.	Burma	D. J. Atkinson.
Examples of eggs, larva and pupæ of the Bee-hole borer teak (*D. ceramicus*).	Burma	D. J. Atkinson.
1 Pupa and imago of a Tineid Moth parasitic on *Pongama glabra*.	Do	Dr. G. R. Tambe.

Fishes, Etc.

80 Fishes	Kachin Hills, Burma...	Lt.-Col. R. W. Burton.
1 Barbus nigra ...	Do. do. ...	Lt. M. G. Sturm.
1 Bufo melanoctictis		
10 Fishes	Bawani R., Coimbatore	Lt.-Col. R. W. Burton.
3 Fishes	Mosul, Mesopotamia ...	Major O. G. Kiernander.
6 Land Crabs	Rewdanda	M. Madrid.

MINOR CONTRIBUTIONS FROM :—

Agricultural Office, Poona ; Mrs. Newland, Moradabad ; Dr. F. H. Gravely, Madras ; Range Forest Officer, Dhullia ; L. D. Edmonstone, Pyinmana, Burma ; Officer Commanding, Chitral Drosh ; Medical Officer, Barabkeys Dispensary, Banda, U. P. ; Forest Zoologist, Burma ; Lt. M. G. Sturm, Belgaum ; Capt. F. H. Peppe, Basti State, U. P. ; Superintendent, Medical Hospital, Dharwar ; Medical Officer, Sakri, West Khandesh ; Civil Surgeon, Raipur, C. P. ; Chief of Rathore, Kharwa, Ajmere ; Officer Commanding, Indian Military Hospital, Mardan ; Hari Narayan Acharya, Ahmedabad ; Civil Surgeon, Narsingpur ; Bharat Dispensary. Barda, U. P. ; Head Quarter Hospital, Bhawani ; Dr. D. A. Turkhud, Kodaikanal ; F. Owen O'Neill, Poona ; Medical Officer, Bhavani ; Medical Officer, Nuzoid ; Officer Commanding, Indian Medical Hospital, Santa Cruz ; Lt.-Col. J. Oxley, Assam ; V. S. La Personne, Bombay ; Rev. Fr. J. F. Caius, Haffkine Institute, Parel.

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CONTENTS OF VOLUME XXXIV, No. 4

PAGE

THE GAME BIRDS OF THE INDIAN EMPIRE. By E. C. Stuart Baker, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U., Part III. (*With a coloured plate*). 859

THE REVISION OF THE FLORA OF THE BOMBAY PRESIDENCY. By Rev. E. Blatter, S.J., Ph.D., F.L.S. Part XIV. 877

THE BIRDS OF THE PROME DISTRICT OF LOWER BURMA. Part II. By J. K. Stanford, I.C.S. and Dr. Claud B. Tieehurst, M.D., M.A., M.B.O.U., F.R.G.S. 901

PROPOSED CLASSIFICATION OF THE SMALLER INDIAN FIELD (OR JUNGLE) MICE. By T. B. Fry, I.F.S. (Retd.) 916

SOME BIRDS FROM THE NORTH-WEST CORNER OF FARS, PERSIA. By E. C. Capito. (*With a map*). 922

A NEW CEROPEGIA FROM THE WESTERN GHATS. By Rev. E. Blatter, S.J., Ph.D., F.L.S., and C. McCann, F.L.S. (*With a plate*). 936

NOTES ON SOME RATS DAMAGING CROPS IN SOUTH INDIA. By P. N. Krishna Ayyar, B.A. 937

THE NESTING HABITS OF THE BAYA (*Ploceus philippinus*). By Salim A. Ali, M.B.O.U. ((*With 7 Plates and 11 text figures*). 947

INDIAN DRAGONFLIES. By Col. F. C. Fraser, I.M.S., F.E.S. Part XXXVI. ((*With 7 text figures*). 965

THE FISH-SUPPLY OF THE WEST COAST OF INDIA. By Sir Reginald Spence, Kt., M.L.C., F.Z.S, and S. H. Prater, C.M.Z.S., M.L.C. 973

FLOWERLESS PLANTS. By Mrs. M. Robinson, B.A. Part V. (*With 7 Plates*). 992

THE BUTTERFLIES OF COORG. By J. A. Yates. Part I. 1003

THE PANTHER AS I HAVE KNOWN HIM. By Lt.-Col. A. H. E. Mosse, I.A., F.Z.S. Part IV. 1015

THE BULBULS OF THE NILGIRIS. By Capt. F. N. Betts........ 1024

NOTES ON INDIAN *Thysanoptera* WITH BRIEF DESCRIPTIONS OF NEW SPECIES. By T. V. Ramakrishna Ayyar, B.A., Ph.D., F.Z.S. (*With two plates and a text figure.*) 1029

THE NATURAL HISTORY OF *Calotes versicolor* (BOULENGER) THE COMMON BLOOD-SUCKER. By J. J. Asana. 1041

EDITORIAL 1048

THE TOXICITY OF THE VENOMS OF INDIA SCORPIONS. By Fr. J. F. Caius, S.J. 1051

MISCELLANEOUS NOTES—

I.—Wanted Bears. By R. I. Pocock, F.R.S. 1052

II.—On the food of the Vampire Bat (*Megaderma lyra*). By Lt.-Col. A. H. E. Mosse, I.A. 1052

III.—The Striped-necked Mungoose (*Herpestes vitticollis*). By Major E. G. Phythian Adams, I.A. (Retd.). 1054

PAGE

IV.—The Indian Wild Dog (*Cuon dukhunensis*). By R. C. Morris. ... 1054

V.—Measurements of a large Indian Wolf. (*Canis pallipes*). By Private Secretary to the Heir-Apparent of Dewas, Sr. ... 1055

VI.—Courage and cowardice of the Hyæna. By Major C. W. Sanders. ... 1055

VII.—Measurements of Big Game. By Lt.-Col. C. H. Stockley... 1056

VIII.—Drumming sound made by Leopards. By T. R. Livesey. ... 1056

IX.—Malformation in skull of a Thar (*Hermitragus jemlaicus*) By Lt. R. K. M. Battye. (*With a photograph*). ... 1057

X.—Abnormal horns of Sambhar. By Lt.-Col. R. W. Burton, I.A. (Retd.). (*With a photo*). ... 1058

XI.—A variety of the Thamin or Brow-Antlered Deer (*Rucervus eldi*). By Lt.-Col. R. W. Burton, I.A. (Retd.). ... 1059

XII.—Swamp Deer (*Cervus dauvaucelli*) head with nineteen points. By R. Powell. (*With a photo*). ... 1060

XIII.—The occurrence of the Grey Hypocolius (*Hypocolius ampelinus*) in North Konkan. By Salim A. Ali. ... 1061

XIV.—Courtship of the Scarlet Minivet (*Pericrocotus speciosus*). By C. McCann. ... 1061

XV.—Description of and notes on the female Chestnut-mantled Koklas (*Pucrasia m. castanea*) from Chitral. By V. S. LaPersonne. ... 1062

XVI.—Casualties among the eggs and young of small birds. By Salim A. Ali. ... 1062

XVII.—The origin of mimicry in Cuckoos' eggs. By Salim A. Ali... 1067

XVIII.—Notes on the Pied Crested Cuckoo (*Clamator jacobinus*) in Alibag Taluka. By Salim A. Ali. ... 1071

XIX.—Birds observed in the neighbourhood of Ranikhet. By F. S. Briggs. ... 1072

XX.—Hovering flight of birds and no wind. By H. A. Allard. ... 1079

XXI.—Pelicans and Turtles. By D. S. Laud. ... 1081

XXII.—Little Indian Grebes or Dabchicks (*Podiceps albipennis*) mobbing a snake. By Lt.-Col. C. C. Hickie. ... 1081

XXIII.—Cannibalism in the Indian Cobra. By Beni Charan Mahendra. ... 1082

XXIV.—Unusual size attained by the Common Krait (*Bungarus caeruleus*.) By Capt. F. J. Rimell. ... 1083

XXV.—An unusually large Shaw's Rat Snake (*Zamenis fasciolatus*) By Lt.-Col. K. G. Gharpurey, I.M.S. ... 1084

XXVI.—Snakes of Nasik. By Lt.-Col. K. G. Gharpurey, I.M.S. ... 1085

XXVII.—Occurrence of *Charasia dorsalis* outside the Mysore Plateau. By S. G. Manavala Ramanujan. ... 1086

PAGE

XXVIII.—Some measurements of the Estuary Crocodile (*Crocodilus porosus*) from Sarawak. By E. Banks. 1086

XXIX.—The ways of fishing shikaris. By Col. A. E. Mahon. 1088

XXX.—A leaf-mining Moth. By Dr. G. R. Tambe, M.A., B.SC., L.M. & S. 1091

XXXI.—Specific identity of the Butterflies (*Terias venata* and *T. læta*). By Lt.-Col. A. H. E. Mosse, I.A. 1094

XXXII.—The Grasshopper (*Isopera pedunculata*). By Major R.W.G. Hingston, I.M.S. 1095

XXXIII.—A live beetle in the external auditory meatus of the human Ear. By Lt.-Col. A. G. Tresidder, C.I.E., I.M.S. 1096

XXXIV.—The effects of the bite of a Centipede ((*Scolopendra sp.*). By C. McCann. 1097

XXXV.—A Centipede after its moult (*Scolopendra sp.*). By C. McCann. 1097

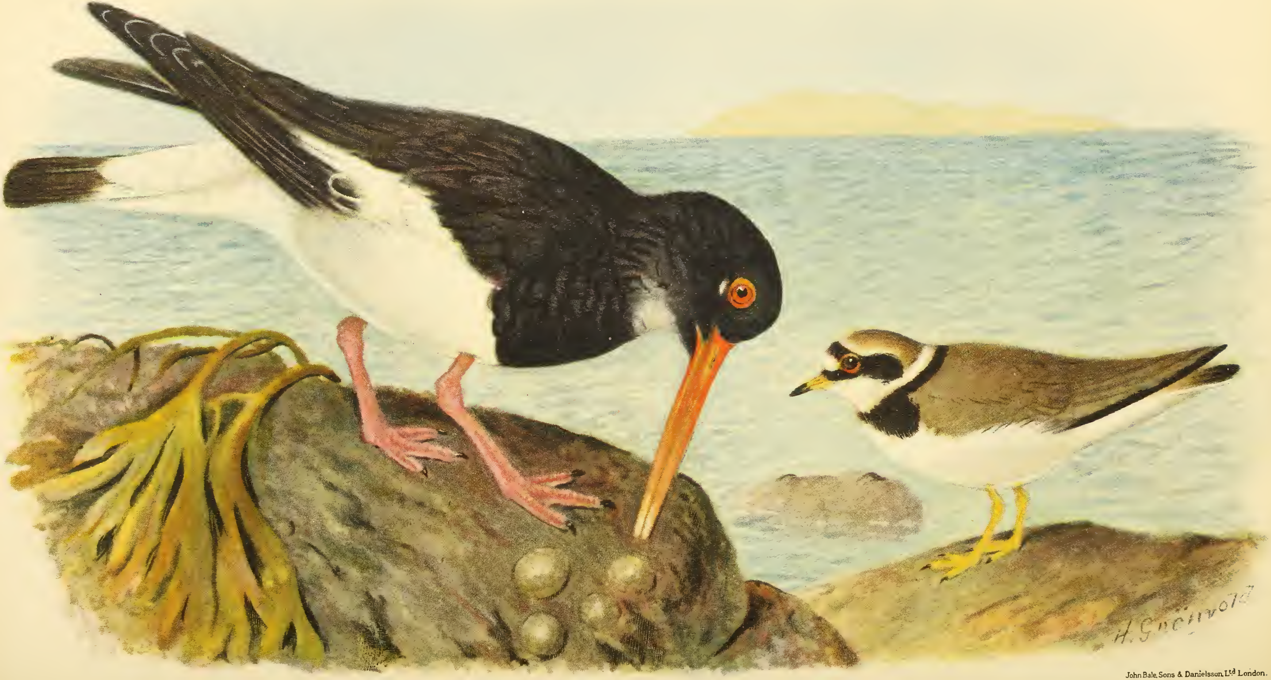
XXXVI.—Some Notes on the flowering of Bamboos. By Rev E. Blatter, S.J. 1097

XXXVII.—On the flowering of Bamboos. By N. E. Perry, I.C.S. 1099

XXXVIII.—The Fern-Palm (With a Photo). By D. S. Laud. 1101

XXXIX.—An abnormal fruit of *Dipterocarpus tuberculatus*, Roxb. By L. P. Khanna, M.SC., F.I.S. 1102

PROCEEDINGS. 1103



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The Chinese Oyster-catcher. 2/5.
Haematopus ostralegus osculans.

The Indian, or Jerdon's Little Ringed Plover. 2/5.
Charadrius dubius jerdoni.

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THE GAME BIRDS OF THE INDIAN EMPIRE.

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V.

THE WADERS AND OTHER SEMI-SPORTING BIRDS.

PART XIII

(*With a coloured plate*)

(*Continued from page 622 of this volume.*)

Genus : HÆMATOPUS.

Hæmatopus Linn., Syst. Nat., i, 10th ed., p. 152 (1758).

Type by mon., *N. ostralegus* Linn.

In this genus the bill is very long, compressed and slightly truncated at the end ; the nostril is linear, narrow and placed near the base of a groove, which extends about half-way to the tip of the upper mandible; the wings are long and pointed, with the first primary longest ; the tarsus is short, stout and reticulated throughout ; there is no hind toe and the anterior toes are short, stout, narrowly edged with a membrane and slightly webbed between the toes, more especially between the third and fourth.

The genus is cosmopolitan, one species, with several races, being represented in India.

The Oyster-Catcher of Europe has been divided by Salomonsen into three races (*Ibis*, January, 1930, pp. 56–60) as follows :—

(1) *Hæmatopus ostralegus ostralegus.* Type-locality Oeland, breeding in Scandinavia.

(2) *H. o. occidentalis.* Type locality not yet defined, breeding in Holland and Great Britain.

(3) *H. o. malacophaga.* Breeding in Iceland and the Faroes.

When in Finland in 1928 and again in 1929 I was struck with the fact that the eggs of the Finnish birds averaged much smaller than those of the English ones but I could find no satisfactory character by which to differentiate the two except that the specimens of *proved* breeding birds showed considerable differences in the structure of their bills. On the other hand the mass of material in various Museums, some of which might also have been of breeding birds, showed a very wide range of variation and I therefore refrained from splitting. In 1929 Neumann divided the Scandinavian and English birds on the shape of their bills, that of the former being slighter and much more pointed and that of the latter stouter and more wedge-shaped. The heavier, bigger form from Iceland does not appear to occur in India, but the other two undoubtedly do, though at present I have not been able to determine their respective ranges and I therefore deal with all under the title *Hæmatopus ostralegus ostralegus.*

HÆMATOPUS OSTRALEGUS

Key to Sub-species

A. Bill shorter, culmen 77 to 90 mm.; wing shorter, 240 to 261 mm. ... ... *H. o. ostralegus.*
B. Bill longer, culmen 80 to 98 mm.; wing longer, 262 to 282 mm. ... ... *H. o. osculans.*

HÆMATOPUS OSTRALEGUS OSTRALEGUS.

The Oyster Catcher.

Hæmatopus ostralegus Linn., Syst. Nat., 19th ed., p. 152 (1758) Oeland, Blanf., and Oates, iv. p. 245.

Vernacular Names.—Darya gajpaon (Hind.); *Yerra-kaliulanda* (Tel.).

Description.—Whole head, neck, upper back, scapulars and inner secondaries black; lower back, rump and upper tail-coverts white, the last tipped with black; tail black with white base, broadest on the outermost rectrices; wing-coverts black, the greater with broad white edges, forming with the white outer secondaries a broad wing-bar; primaries black, the first three with long, white streaks on the inner webs; the fourth with a white shaft-patch near the tip, increasing to a broad white patch on the sixth to eighth primaries; remainder of lower parts white.

Colours of soft parts.—Iris red or orange-red; bill bright orange-red, paler and duller at extreme tip; legs and feet dull brownish-purple or purple-red.

Measurements.—Wing 240 to 261 mm.; tail 99 to 114 mm.; tarsus about 48 to 54 mm.; culmen 77 to 90 mm.

Young birds are browner and have the feathers of the mantle narrowly edged with whitish; the centre of the chin and throat are more or less white and there is a broad patch of white on the fore-neck.

Nestling in down.—Upper parts sandy-brown; crown mottled with black, especially in the centre; a U-shaped black mark on lower back and rump; tail black, stippled with rufous barring;

chin and throat fulvous-brown with black bases, fore-neck with a still blacker patch; rest of underparts white, thighs mottled brown and fulvous.

Distribution.—The sea-coasts and islands of the greater part of Europe and Western Asia. In winter South to Sind, Cutch and Kathiawar in great numbers, less common in South but recorded from Ceylon. Records from Eastern India and Burma probably all refer to the next race.

Nidification.—The Oyster-Catcher breeds over the greater part of Northern Europe, commencing to lay during the last week of April in the more temperate regions, whilst further North it does not lay until early June, often continuing well into July. The favourite site for the nest is undoubtedly a shingle bed on the seashore but, where the bird is common, it often breeds far inland on the banks of streams and lakes and even in fields and ploughed lands, whilst in Scotland its nests may be actually many miles from the sea on the heather-clad tops of the hills and mountains. Very often most curious sites are selected. A Cumberland bird chose the top of a boundary wall and every year laid its three eggs in this rather precarious position, more than once having them blown over in the high gales. Even this, however, never made her desert the place and one lot of eggs destroyed, she promptly laid another in the same nest and generally succeeded in hatching them. In Finland I twice found them breeding on the roofs of the houses built in marshes by the Finns to hold their winter store of hay and I was informed that one of these pairs built every year on the same roof. Where they are very numerous, the birds sometimes breed almost in colonies and thus I remember in Wigtownshire on one occasion finding no less than 42 nests in the space of a couple of hours and in an area containing two fields of short stubble grass and a short stretch of foreshore. The nest is as a rule just a scratch in the shingle made by the birds with their feet and carefully lined with bits of shell, small white pebbles or similar material. In Norfolk I have on several occasions found the nests lined entirely with small rabbit bones obtained from the carcases of the many rabbits which perish annually in the floods which cover the marshes adjoining the sandhills in which they breed. Rarely one may find a nest without any lining at all but this is quite exceptional. Generally the nests will be found in a quite open space but I have occasionally seen them laid in amongst *marram* grass on sand hills and of these I have seen one or two completely concealed by the surrounding high grass. They have also been found in patches of pea or potato cultivation and there is one record of a nest having been taken in a cabbage patch behind a watcher's garden. Very often the Oyster-Catcher makes its first nest so close to the sea that it is flooded out at the first high tide and it is a curious fact that the birds do not seem to learn by experience, for one pair of my acquaintance annually make their nest with great care on the long shingle bank so close to the water that the eggs get washed out at the first high tide. The second nest was then made well above high water mark, yet the following year the birds again made it at the bottom of the bank and were again washed out.

The full clutch of eggs numbers three or four, in some places, four being more common, whilst in others three is the usual number. Occasionally two only are laid. In colour they vary from a pale buff stone to a rather rich yellow or buff and they are marked more or less thickly with spots and blotches of dark brown and reddish brown, with others underlying them of grey or natural tint. In some eggs the blotches become scrawls and lines and a few eggs may be found which are scrawled all over, though, on the whole, variation in the eggs of the Oyster-Catcher is not great. In Finland I came across several clutches which were a very distinct green in tint, in one clutch almost dark green but this colour, as also the richest tint of buff, fades very quickly after the eggs are blown and in a very short time the eggs become drab and ordinary looking. Jourdain gives the average of 100 eggs as 57·0 x 40·0 mm. but this probably includes only British eggs and the Norwegian and Finnish eggs which I have measured only average 54·6 x 37·2 mm.; maxima for all eggs are *70·1* x 37·4 mm. and 62·1 x *48·9* mm.; minima *51·6* x 40·4 mm. and 62·6 x *35·0* mm.

There are several records of five, six or seven eggs being found in an Oyster-Catcher's nest but these are nearly always the production of two females. In Norfolk two pairs of birds at one time bred every year on the same shingle bed but the male of one of these pairs died and the lady joined forces with the other pair and every year the two hens laid in the same nest and took by turns to carry on the domestic duties. These two hens usually laid three eggs each but on one occasion one of the females laid four and this proving too much for one bird to cover satisfactorily, the watcher in charge took one of the eggs away.

There is probably no bird more difficult to catch on its nest than the Oyster-Catcher for it is not only extraordinarily shy but it is exceptionally clever in detecting the approach of any enemy. The cock bird, who is always on the watch gives its mate very early warning and both birds immediately leave the vicinity of the nest. Rarely, when the eggs are very hard-set they will fly whistling over the head of the intruder, getting more and more excited as the latter gets closer to the eggs but it is very rare that one can judge the exact position of the nest from their cries. On the other hand, when the birds are very young, the parents at once come to meet any supposed adversary, whistling plaintively the whole time and more and more excitedly the nearer he gets to the chicks and, so definite are their cries, that it is generally easy to spot the whereabouts of the youngsters, however difficult it may be actually to find them. Unlike the Terns, Ring Plovers and other birds, young Oyster-Catchers are almost invariably taken by their parents into cover as soon are they are hatched and directly the warning notes are uttered by their parents they crouch in amongst the roots of the grass and are almost impossible to locate. If found, the little things lie perfectly still with their eyes tight closed, to all appearances dead but, if the finder moves back a pace or two, the eyes open and in a second the chick slinks away and once more becomes invisible.

Habits.—The Oyster-Catcher is essentially a bird of the sea-coast but exceptions are numerous and it may be often found far inland on the shingle banks of rivers and indeed high up on the hills. In India, however, except during migration, it will seldom be found anywhere but near the sea or the estuaries of big rivers adjoining it. Even in India it is an extraordinarily shy wild bird and extremely difficult to approach within shot, whilst its loud plaintive whistle soon puts every other bird in the vicinity on the *qui vive.* It is said to be eatable but it is certainly not worth shooting from any point of view beyond the difficulty with which it is approached. In India it is found principally in small flocks and singly, whilst in Europe during the winter it is often found in flocks of immense size, numbering perhaps several hundred. A certain number of birds may also be found in small flocks during the summer in North-West India, but these are undoubtedly non-breeding birds of the first year, for even in England similar male flocks may be seen throughout the year associating and feeding at the edge of the sea, whilst others are busy breeding. The cock birds seem also to collect occasionally in small flocks, whilst the hens are sitting, but these only remain together for a few hours at the most, as the cock birds themselves take an interest in the eggs and probably sit for a few hours during the night. They feed almost entirely on small crustacea and insect food and they are adepts at obtaining the contents of the various mollusca, forcing the limpets off the rocks by using their bills as a wedge between the shell and the rock, whilst they also chisel out, as Ticehurst calls it, the contents of the various shellfish very cleverly. Their call is a loud and very plaintive whistle rapidly repeated and varying in strength and shrillness according to whether it is an alarm note or warning note, or an ordinary call to its mate.

Burturlin separates our Western Asian form of Oyster-Catcher under the name of *longipes*, but I cannot separate the bird, although there are large series available for examination. Ticehurst and some other ornithologists, however, consider it a good race. It is supposed to be distinguishable by its longer bill and in having more white on the throat in winter.

HÆMATOPUS OSTRALEGUS OSCULANS.

The Chinese Oyster-Catcher.

Hæmatopus osculans Swinhoe, P. Z. S., 1871 p. 405 (N. China).
Hæmatopus ostralegus Blanf. and Oates, iv, p. 245 (part).

Vernacular Names.—None recorded.

Description.—Similar to the preceding bird but larger and with a decidedly longer bill; the amount of white on the primaries is generally, but not always, less, the first primary seldom showing any white at all on the inner web.

Colours of soft parts as in the typical race.

Measurements.—Wing 262 to 280 mm.; tail 101 to 112 mm.; tarsus about 52 to 58 mm.; culmen 80 to 98 mm.

Distribution.—Japan, North China to North Burma and extreme Eastern Bengal.

Nidification.—Nothing recorded. An Oyster-Catcher, which is probably of this race, has been obtained, with its eggs, breeding on an island in the Sunderbunds, but the skin has not been available for comparison.

Habits.—Very little known or recorded. Thisform has always been considered a migratory race, breeding in the North and only visiting India in the cold weather but it is possible that some may remain to breed in suitable places. In Assam it occurred on the bigger rivers but apparently always on migration and moving North and South; in Eastern Bengal I never personally saw it during breeding season but I never visited the islands in the mouths of the Ganges and Brahmaputra where its eggs were taken. The few birds I have seen behaved, whistled and flew just like the European birds and were equally wild and difficult to approach. They were generally in small flocks, more rarely singly or in pairs.

Subfamily CHARADRIINÆ.

Dr. Lowe thus diagnoses this subfamily :—' Pluvialine forms in which the lacrymals are not free but are merged on the supraorbital rim, in which there is a conspicuous foramina for the nasal duct immediately *caudad* of the nasals, in which the supraorbital grooves are deeply sculptured, often perforated with foramina, and extend well back to the anterior margins of the parietals, and in which the supraorbital rim is conspicuously raised, everted, or conicid.'

Key to Genera.

A. A white ring round the neck ...	*Charadrius.*
B. No white ring round the neck.	
(*a*) Plumage brown above, not spotted yellow	*Cirrepedesmus.*
(*b*) Plumage above spotted with yellow, no dark band across the chest.	*Pluvialis.*

Genus : CHARADRIUS.

Charadrius Linn., Syst. Nat., 10th ed., p. 150 (1758).

Type by taut, *Charadrius hiaticula* Linn.

In the genus *Charadrius*, as now restricted, we have the Ringed Plovers only, distinguished from the other genera by having a white ring round the neck as well as by certain structural characters. In appearance they are very like the genus *Leucopolius*, containing the Kentish Plovers, but these latter have the lacrymals free; the plumage of the young also differs somewhat. *Charadrius* has three toes and the tarsi reticulated; the wing is long with the first primary longest.

Key to Species.

A. Shafts of all primaries white near end; wing 129 to 138 mm ...	*C. hiaticulus.*
B. Shaft of first primary white throughout, of others dark; wing 102 to 121 mm	*C. dubius.*
C. Shafts of all primaries dark, or first only white near tip; wing 139 to 152 mm.	*C. placidus.*

CHARADRIUS HIATICULUS.

Charadrius hiaticulus Linn., Syst. Nat., i, 10th ed., p. 150 (1758).

Type-Locality ; Sweden.

The typical form is slightly larger than the Eastern form and decidedly paler.

CHARADRIUS HIATICULUS TUNDRÆ.

The Eastern Ringed Plover.

Ægialitis hiaticola tundræ Lowe, Bull, B. O. C., xxxvi, p. 7 (1915) (Yenesei).

Ægialitis hiaticula Blanf. and Oates, iv, p. 243.

Vernacular names.—None recorded.

Description. Forehead, lores to upper ear-coverts black; a broad line across the forehead from eye to eye white; anterior crown black; under and behind the eye a white semi-ring, a short broad supercilium white; crown and nape brown; a white collar on the hind-neck, followed by a broad black band; upper parts dark brown; primaries blackish, the shafts white in the middle, brown at the base and tip and with a white patch on the outer web of the fifth to the secondaries, increasing on the latter till the central is nearly all white, then decreasing until the inner are like the back; tail brown with a broad subterminal white band and white tip, the latter increasing until the outermost pair of feathers are almost pure white; the black forehead is continued as a broad band to to ear-coverts; chin, throat and sides of neck white, meeting the white hind-collar; a broad band of black across the fore-neck and upper breast meeting the black hind collar; remainder of underparts white.

Colours of soft parts.—Iris brown; eyelids yellow; bill orange-yellow, the dertrum black; legs and feet orange-yellow.

Measurements.—Wing 120 to 138 mm.; tail 52 to 64 mm.; tarsus about 22 to 26 mm.; culmen 13 to 15 mm.

Young birds have no black on the head or breast, this being replaced by brown; the black breast when first assumed has whitish fringes.

Nestling in down.—Crown and lower back greyish-buff speckled with darker brown : a black line through the eye round the nape and a U-shaped black mark on the lower back : hindneck and underparts white.

Distribution.—Finnish Lapland, through Northern Russia to East Siberia. In winter South to Persian Gulf, India and China, extending to N. E. Africa.

Exactly how far West this form of Plover extends is difficult to determine. The birds of Northern Finland undoubtedly average darker and slightly bigger than our British birds and the Finnish ornithologists now consider all their breeding birds to be *tundræ*. With this I am inclined to agree and I think all our Indian birds must come under this name.

Nidification.—The Eastern Ringed Plover breeds from North Finland to Eastern Siberia, commencing to lay in the more Southern parts in the end of April, whilst fresh eggs may be obtained in the far North as late as the middle of July. We found it breeding in considerable numbers both on the foreshores of Northern Finland and on the numerous islands adjoining, selecting sites both on the shingle and sand coast and on the fine grass covered sand hills adjoining them. On some of the larger islands they were particularly numerous and we once saw five nests within a distance of about 30 yards, all containing three or four eggs. The nest is exactly like that of its British cousin, a scrape in the shingle or sand, generally, but not always, lined with tiny white pebbles and scraps of shell. The favourite position is amongst the debris collected on the high water mark, about three out of every five nests being placed with a yard or two of this line. Very often the birds select a spot which has some conspicuous land mark near it, such as a log washed up by the sea, a conspicuous boulder or a pile of debris larger than usual. When breeding on the sand hills we found that their nests were generally unlined and were made in amongst thin grass which grew around the tops, nowhere thick enough to conceal them. In such places the nests are very easy to find, for the little birds alight at a short distance from the nest and then run up to it, so that all round each nest there is a net-work traced by their feet and it is very much easier to see the footmarks than it is to see the nest and eggs, although once found they may seem to be very conspicuous. The number of eggs laid is almost invariably four, *very* rarely either three or five, so rare indeed that they may be considered abnormal unless the three represents a second laying. The hen-bird, which I believe alone sits upon the eggs during the day, is a fairly close sitter but much too wary to allow anyone to approach near enough to spot her on the nest, whilst the cock-bird in the manner usual to the plovers, generally keeps a sharp lookout from some point of vantage not very far from where she sits. Nests that are made along the seacoast are not very difficult to find, for even where the shingle prevents the tracks of birds from being seen, if one walks quietly along a few yards above high water mark and keeps a careful lookout ahead, he will generally be able to spot the little plover as it runs down the shore on leaving its nest. The eggs which are rather broad peg-top in shape, vary in colour from a pale yellow or greyish stone to a rather warm buff—or olive-stone. Typically they are marked with fairly numerous but small spots and specks of black, which are most numerous at the larger end where they form an indefinite ring. Secondary markings are scarce and sometimes absent altogether but, when present, in any numbers are generally rather larger than the superficial markings. In colour they are a pale to dark lavender. A series of eggs in my collection average 32·0 × 25·0 mm.

Habits.—In India we find the Eastern Ringed Plover in small flocks or in pairs and in this country they are for the most part confined to the sea-coast and to the banks and islands of our bigger rivers, though they may be occasionally found at very great distances from the sea. They are extraordinarily active little birds, both on the wing and on foot, flying and running with great speed. Their voice is typically plover-like and their shrill but rather sweet call soon draws attention to them. In running they proceed by little spurts, much in the same way as do the various members of the Kentish Plover group and like that bird, its normal attitude when still, has the head well tucked into the shoulder and not extended as it is so often depicted.

Its breeding song, which of course is never heard in India, is a very sweet trisyllabic trill uttered both when in flight ascending and descending and, less often, from the crest of a sand hill or the top of a bank. Its warning note is a single and harsh cry and its ordinary call note a single or sometimes double whistle. It feeds on insects and tiny mollusca, very often in company with other small waders, both of its own species and others. It is not a shy bird during the winter and may usually be approached within shooting distance but it is not worth powder and shot, although it is by no means bad to eat if one has nothing else, though it would take a considerable number to make a dish.

CHARADRIUS DUBIUS.

Key to Sub-Species.

A. Larger. Wing 115 to 121 mm.
  (*a*) Bill longer and less slender, 13 to 14 mm. *C. d. dubius.*
  (*b*) Bill shorter and more slender, 12 to 13 mm. *C. d. curonicus.*
B. Smaller. Wing 102 to 114 mm. .. *C. d. jerdoni.*

CHARADRIUS DUBIUS DUBIUS.

The Chinese Little Ringed Plover.

Charadrius dubius Scop., Del. Flor. et Faun., Insubr., ii, p. 93 (1786) (Luzon).

Ægialitis dubia Blanf. and Oates, iv, p. 241 (part).

Vernacular Names.—None recorded.

Description.—This species is a small replica of the preceding species. It differs in having the shaft of the first primary all white, that of the others all dark brown; there is no white patch on the outer webs of the primaries, and the secondaries are all coloured like the back; the black fore-crown is nearly always divided from the brown by a very narrow white line.

Colours of soft parts.—Iris brown; bill black, the extreme base of the upper and rather more of the lower mandible yellow; legs and feet yellow in breeding season; greenish-yellow, dusky olive or greenish-brown in non-breeding plumage.

Measurements.—Wing 115 to 119 mm.; tail 48 to 58 mm., tarsus 22 to 24 mm., culmen 13 to 14 mm.

In non-breeding and young birds.—The same differences occur as in the Ringed Plover.

Distribution.—South-China and Formosa throughout the Malay Archipelago, the Indo-Chinese countries and once near Mergui in

Tenasserim, whence I had two skins sent me of birds shot in January 1898.

Nidification.—The breeding of the Chinese Little Ringed Plover seems to be very similar to that of our little Indian bird, Jerdon's Ringed Plover. Jones describes it as breeding in very great numbers near Shantung and Wei-hai-wei, where he found them breeding in scattered colonies on the vast areas of sand by the great rivers and in smaller numbers on the sea-coast itself. Latouche also found its nests and eggs at Chihli. The nests are like those of the previous bird but are apparently very seldom lined in any way, being merely hollows scratched in the sand by the birds themselves. The eggs, four in number as usual, vary in colour from a pale cream or yellow buff to a warm reddish buff, whilst the markings consist of tiny specks and spots of dark brown with secondary similar markings of pale grey or lavender. In most eggs they are scattered numerously over the whole surface, but in others are more numerous at the larger end, though they never form definite caps or rings. Sixty eggs average 27·7 by 21·8 mm.; maxima *31·2* by 22 mm. and 30·3 by *23·0* mm.; minima *27·7* by 22·1 mm. and 28·6 by *21·9* mm. The breeding season lasts from the end of April to early June but, according to Jones, the greater number of eggs are laid between May the 20th and June the 10th. Latouche on the other hand took eggs at Chihli as early as the 12th of April.

Habits.—Very similar to those of the other small Ringed Plovers, from which they differ but little if anything in flight, voice and diet. Jones records it as being very much more common in the neighbourhood of fresh water than on the sea-coast more especially during the breeding season. In winter it collects in small flocks sometimes numbering as many as 30 or 40 individuals but even at this period it may sometimes be seen singly or in pairs. Within Indian limits it is only a very rare straggler, occurring occasionally in Tenasserim whence I had two skins sent me of birds which had been shot by one of my collectors on the sea-coast in January.

CHARADRIUS DUBIUS CURONICUS.

The European Little Ringed Plover.

Charadrius curonicus Gmelin, Syst. Nat., i, 2, p. 692 (1739) (Curonia).

Ægalitis dubia Blanf. & Oates, iv, p. 241 (part).

Vernacular Names.—Zirrea (Hind.), *Bytu-ulanka*, *Rewa* (Tel.).

Description.—A decidedly paler bird than the typical form; on an average also the black on the crown and the breast-band is rather less in extent.

Colours of soft parts.—As in the preceding form.

Measurements.—Wing 114 to 121 mm.; culmen 12 to 13 mm.

Distribution.—Breeding throughout Europe; North and Central Asia to North-East Siberia. In winter south to Africa, South-Western Asia and to the greater part of China, India, etc.

Nidification.—The European Little Ringed Plover does not breed within Indian limits but has been found as far south as Turkestan and it also breeds in Northern Persia. Its nests and eggs do not differ from those of Jerdon's Ringed Plover and are found in similar places, that is to say, on sandy and shingly coasts and, less often, by fresh-water lakes and the sandy banks and islands of rivers. In Finland I found them breeding on sand hills at a considerable distance from the sea or from any piece of fresh-water. My first intimation that the birds were breeding in these hills, was the usual mass of little footprints surrounding their nests. One of these, containing four eggs, we found with very little trouble and after we had retired a short distance and hidden ourselves, the female quickly returned to the nest. She showed very little care in approaching it. About thirty or forty yards away she ran to the top of one of the sand hills and had a careful look round and then, apparently satisfied that there was no danger, proceeded by the usual little jerky runs, alternating with brief halts, and settled down on the eggs. The eggs differ from those of Jerdon's Ringed Plover in being bigger, less often reddish or sandy in colour, and not so finely marked. Normally the eggs are pale sandy in ground colour and are numerously speckled with brown and reddish brown, the underlying markings of lavender and grey being few in number and sometimes absent altogether. In size the markings vary from the minutest specks to small spots and blotches and are scattered freely over the whole surface of the eggs but still more numerously at the larger end. Rarely the eggs are more grey-green or yellow in tint and still more rarely the markings assume the character of rather big blotches. A clutch is almost invariably four, though a second laying may consist of three only.

A hundred eggs average 29·8 by 22·1 mm.; maxima *32·8* by 23·0 mm. and 30·1 by *23·5* mm.; minima *27·3* by 21·1 mm. and 28·6 by *21·0* mm. In the more Southern places of its breeding area a few birds lay as early as March, whilst in Northern Europe they commence breeding in May and eggs may be found up to the end of June or even during the first week in July.

Habits.—All the Ringed Plovers have very much the same habits. Their flight is swift and powerful and their progress on foot very rapid and always made in the same way—a quick little run, then a halt and then another run. Their love song, a rather sweet little trill, is uttered in the air, the bird fluttering and then sailing alternately, though they are also said sometimes to display whilst on the ground, trailing their wings, fluffing out their feathers and singing at the same time. This display on the ground I have never seen, although we spent a great many hours watching the birds in their breeding grounds. Their alarm note is a sharp double whistle, like that of the British bird which Witherby syllabifies as 'Whee-ar' constantly repeated. In India during the winter they may be found in small parties on almost all the bigger rivers and lakes as well as on the sea-shore.

CHARADRIUS DUBIUS JERDONI.

Jerdon's Little Ringed Plover.

Ægialitis jerdoni Legge, P.Z.S., i, p. 125 (1880) (Ganges).
Ægialitis dubia Blanf. and Oates, iv, p. 241 (part).

Vernacular Names.—*Zirrea* (Hind.); *Bytu-ulanka*, *Rewa.* (Tel.).

Description.—Differs from both the preceding froms in its much smaller size. The frontal black line is smaller than in *curonicus.* The colour of the base of the bill is a much brighter yellow, whilst the orbital skin is also generally better defined and a brighter yellow; the general colour is paler.

Colours of soft parts.—Except as above noted, the same as in the other races.

Measurements.—Wing 102 to 111 mm.; sexes alike; culmen 11·5 to 12·5 mm.

Distribution.—All India, Ceylon, throughout Burma and the greater part of the Malay States; Siam, Annam and Cochin China.

Nidification.—This Little Ringed Plover is to be found practically throughout the whole of the Indian Empire from Ceylon to Kashmir, making its nest in the usual little scrape in sand or shingle on the shores and islands of rivers or lakes. Less often they are in sandy or shingly ground at some distance from any water. Like its English relative, it occasionally decorates its nest with tiny white stones or shells but this is exceptional. On the other hand, unlike the European bird, the eggs may frequently be found half buried in the sand, nor does this appear to be accidental for I have taken eggs when the weather was so calm that there could have been no movement of the sand, and the eggs appeared to have been partly covered by the birds when leaving the nest. With the Kentish Plover in the tropics this covering of the eggs by the bird seems to be very general, possibly to save them from the heat of the sun and the same reason may induce Jerdon's plover to so protect them.

The behaviour of the birds at the nest differs in no way from that of the previous bird, nor is it any more shy. A full clutch of eggs may be either three or four, as often one as the other. In some places four seems to be the number most often laid, whilst in others, three only is the almost invariable number. Mr. Eates, who found these birds breeding in Sind on mud flats close to the Hubb river, states that four is quite exceptional. It is rather noticeable that this little Plover often lays its eggs in the vicinity of some definite land-mark, such as a piece of fallen timber or a stone somewhat larger than the surrounding shingle, so that when hunting for these birds one should always make an especially careful search around such landmarks. As with the other Little Plovers also, searching for the footmarks is an easy way to obtain the eggs. These latter vary in ground colour from a pale sandy or pale buff to a quite rich reddish buff or brown buff, whilst I have seen a few eggs with a distinctly bluish tinge. The markings are similar to those of the eggs of the preceding bird and differ from those of the Kentish Plover group in consisting of specks and tiny spots rather than of scrawls and lines. The breeding season commences during the last week of February, through March and April to the first week in May, but the great majority of eggs are laid during March and early April, so as to give the birds time to hatch off before the rains come and the rivers are flooded. In Kashmir their eggs may sometimes be taken in June, when the birds breed beside lakes, on ground not likely to be flooded early.

Sixty eggs averge 27·5 by 20·7 mm.; maxima *29·5* by 20·8 mm. and 27·4 by *21·6* mm.; minima *25·0* by 19·6 mm. and 26·1 by *19·9* mm.

The process of incubation is 21 days.

Habits.—This Little Plover is found wherever there are rivers with clean sandy or shingly banks or islands but it never or very seldom frequents those in the alluvial plains with muddy banks. In some places such as already referred to above in Sind, they may occasionally be found on the sun-baked mud flats, but they desert these as soon as there is sufficient rainfall to make them soft and muddy. Their actions both on the wing and on the ground are like those of the preceding bird and their voice is similar but I think rather shriller, nor are they quite such noisy birds. If one invades the breeding haunts of the European Ringed Plover, the birds often display considerable anger and continue whistling round the intruder for some time but our little Indian bird seems to take things much more calmly and seldom utters much protest even when the eggs are taken, though their excitement is greater once the young are hatched. I have on several occasions been fortunate enough to witness the courtship of this pretty little wader. As a rule, the male bird soars into the air uttering his sweet trill and then with quivering wings he drops in a slow loop towards the ground, again mounting into the air and repeating the drop at quick intervals. Sometimes the lady joins in the flight and sometimes both birds descend to the sand bank and the male displays as he runs about trilling nearly all the time. Whilst thus engaged, his wings and tail shivering until they almost touch the sand, he runs backwards and forwards in quick runs, after every two or three runs bobbing and bowing and then repeating his exercises. The little lady for the most part contents herself with the more serious business of searching for food, but occasionally she too may indulge in a few little runs and bows. Their food consists of the usual tiny crustacea, etc., consumed by all the small plovers but this bird often seizes flies and other small insects on the wing and is very expert in catching them.

CHARADRIUS PLACIDUS.

The Long-billed Ringed Plover.

Charadrius placidus Gray, Cat. Mam. Birds Nepal, p. 70 (1863) (Nepal).

Ægialitts placida Blanf. and Oates, iv, p. 244.

Vernacular Names.—None recorded.

Description.—Very similar to the Ringed Plover but larger and with a much larger bill. The shaft of the first primary is brown, paler and yellowish towards the tip but never white; the black on the lores and cheeks is replaced by brown or blackish-brown; the forehead is wholly white.

Colours of soft parts.—Iris brown; bill black, the gape and extreme base of lower mandible yellowish; legs, feet and margins of eyelids yellow.

Measurements.—Wing 139 to 152 mm.; tail 76 to 78 mm.; tarsus about 31 to 34 mm.; culmen 18 to 20 mm.

Distribution.—Breeding throughout Eastern Siberia, Manchuria, Japan and North-Eastern China. In winter migrating South to Southern China, Burma, Indo-Chinese countries and Northern India. It has been obtained in Nepal, Sikkim, Bhutan Duars, Assam and Eastern Bengal.

Nidification—Mr. J. D. Latouche found this bird breeding in some numbers during April and May in North-East Chihli and in the *Ibis* of 1921, p. 20, he describes the taking of these eggs as follows:—

> 'On the 2nd of May of that year I went out to search for the eggs myself with a camera and during the course of the hunt, saw several empty nests. One containing four eggs was found and an attempt to photograph the bird on the nest having failed, I took the eggs which were incubated, but not too far advanced to preserve. The nest, like all the others seen that day, was a round depression among the shingle and had a thin lining of scraps of twigs or grass. The nests were placed among the stones some distance from the water. The birds lay from about the middle of April to the first week in May.'

The eggs are very typical of the genus. The ground colour is very pale sandy, rarely with a tinge of buff, but generally with a curious livid tint. The markings consist of the usual tiny specks and freckles but are of pale reddish or reddish brown and are less numerous than those normally found in the eggs of any of the preceding species of Ringed Plover. On the other hand the secondary markings of pale grey are comparatively more numerous and easily discernible. They are of the usual Ringed Plover's egg shape, broad ovals, sharply pointed at one end, in some cases almost pegtop-shaped.

The average of thirty eggs measured by Latouche is 35·9 by 26·4 mm. In my own series the maxima are *37·0* mm. by 26·9 mm. and 35·0 by *27·2* mm.; minima *34·6* by 26·9 mm. and 35·4 by *26·0* mm.

The number laid seems to be almost invariably four, rarely three only. Staff-Surgeon Jones in a letter to me describes the birds as being noisy, showing their displeasure loudly when he visited their breeding haunts, circling round overhead and calling loudly all the time. It is probable that at this time (June) many of the birds had young and it is possible that they are not so noisy before the eggs are hatched. They seem to breed in colonies although these may be scattered over a considerable area and their breeding haunts include both the wide stretches of sandy seashore and the banks and islands of the bigger rivers.

Habits.—Latouche describes the birds as not very shy and though he disturbed some from their eggs, they returned very quickly. According to Chinese observers the Long-billed Ringed Plover appears to be resident over the greater part of its area for Lactouche considers it to be a resident bird in Chihli, Fokhien and even in Western Yunnan. Even if this is so, however, it certainly extends further South and West during the winter, occurring not uncommonly in Burma and rarely even in Eastern India during the cold weather. In the Indo-Chinese countries its status is not yet known as well as it might be and it is possible that the so-called migrants in these countries may really be resident birds. The flight, voice and food, so far as these have been described, seem to by very like those of its smaller relations. I can give no description of its courting habits or song.

Genus : CIRREPEDESMUS.

Cirrepedesmus Bonaparte, Compt. Rend. Acad. Sci. Paris, xliii, p. 417 (1856).

Type by taut, *Charadrius atrifrons* Wagler.

In this genus there is no white ring round the neck and the bill is decidedly shorter than in *Charadrius* and is shorter than in *Pagoa*, the dertrum is much swollen and occupies about half the culmen ; the legs are comparatively short, the feet medium and the tarsus reticulated throughout. I cannot separate the Large Sand-Plover generically from *Cirrepedesmus*, all the characters seeming to be the same except that *Pagoa*, which Mathews creates for the Large Sand-Plover, has a slightly longer bill.

Key to Species.

A.	Bill shorter than middle toe without claw...	*C. mongolus.*
B.	Bill longer than middle toe with claw ...	*C. leschenaultii.*

CIRREPEDESMUS MONGOLUS.

Charadrius mongolus—Pallas, Reise Russ. Reichs, iii, p. 700, 1776.

Type-locality ; Salt Lakes of Mongolia.

Differs from the form occurring in India in having the forehead pure white; the chestnut-rufous of the breast is deeper and the colour of the upper plumage a little darker.

CIRREPEDESMUS MONGOLUS ATRIFRONS.

The Pamirs Lesser Sand-Plover.

Charadrius atrifrons Wagler, Isis, 1829, p. 650 (Bengala).

Ægialitis mongolica Blanf. and Oates, iv, p. 238.

Vernacular Names.—None recorded.

Description. Forehead, lores, cheeks and ear-coverts black, more or less marked with white ; anterior crown, supercilia and hind-neck pale fulvous-chestnut ; posterior crown and upper plumage cinereous-brown, the shafts faintly darker ; sides of the rump and upper tail-coverts white ; tail brown with white tip, the outermost feathers nearly all white ; primaries blackish, the whole of the shaft of the first primary and the terminal halves of the others white ; a white patch on the sixth and succeeding primaries on both webs ; outer secondaries tipped white ; chin, throat and fore-neck white ; upper breast and sides of lower breast pale chestnut-rufous ; remainder of lower plumage white.

Colours of soft parts.—Iris brown ; bill black ; legs and feet fleshy-grey, yellowish-olive to bluish or olive-slate colour.

Measurements.—Wing 124 to 129 mm.; tail 44 to 53 mm.; tarsus 33 to 34 mm.; culmen 16 to 18 mm.

In non-breeding plumage the forehead, lores and ear-coverts are fulvous, the ear-coverts mixed with brown; the collar on the hind-neck is obsolete or wanting and the rufous on the breast and flanks is much less in extent.

Young birds have pale fringes to the feathers of the upper parts.

Downy chick.—' Forehead buff, nape-ring buffy white; upper parts warm buff marked with brownish black tending to run into lines; lower parts white tinged with buff on lower throat (pectoral band) and on the sides of the head; bare skin on sides of neck blackish.' (H. Whistler.)

Distribution.—This Sand-Plover breeds in the Pamirs and throughout the higher plateaus of Kashmir, Ladak, Tibet and North-West China. Probably also in Turkestan and parts of Southern Siberia. In winter it is found over an enormous area of Africa and Southern Asia. In India it occurs commonly on the coasts of North-West India as far south as Bombay and more rarely further south and inland on the bigger rivers. It occurs in the Andamans but certainly does not breed there normally, though Hume received skins of young birds obtained there in May, July and September.

Nidification.—Mr. B. B. Osmaston (*B.N.H.S. Journal*) says that he found these birds ' breeding in Rupshu near the Tsokar and Tsomoriri Lakes about 15,000 feet, on the Indus at 13,000 feet, between the Indus and Shushar at 14,000 to 14,500 feet and along the Pangkong lake at 14,000 feet. They were also found breeding in the Suru Valley at about 13,000 feet.'

He also records in Vol. xxxii. of the same *Journal*:

' The egg-laying commences about the middle of June and it continues until the middle of July. Three eggs only are laid in a slight depression scraped in the mud amongst stones or shingle.'

' The nest, or rather nest cavity, for there is no nest, is very difficult to locate. The parent bird if disturbed by the approach of a man when incubating, gets up off the eggs very quickly and slinks away with lowered head after the manner of many other plovers. When returning to its eggs, the approach is made very cautiously and great care is necessary, even with the advantage of a pair of field glasses, not to lose sight of the bird in the stretch of sand and stones among which it moves in a series of short runs.'

' The eggs are slightly pyriform and without gloss. The ground colour is *cafe au lait* sometimes with a distinct warm tinge, speckled more or less all over with dark-brown markings.

' The eggs vary in length from 38·2 to 35·4 mm. and in breadth from 27·2 to 25·6 mm., the average of twelve eggs being 36·7 by 26·3 mm.'

Mr. Hugh Whistler also found this bird breeding in Lahul in 1922 at about 14,000 feet at the Chandra Lake, obtaining two clutches each of three eggs and three downy young, the description of which is given above. In 1923 he obtained them on the Northern slopes of Baralacha Range where on the 23rd and 26th of July he found odd birds and a party (the latter evidently consisting of the old birds and fully fledged young). His descriptions of the nests and eggs agree well with that of Mr. Osmaston, but he records that in one of his nests there was a sort of rough lining of broken chips and fragments of stem of a small creeping ground plant. (*Ibis*, 1925, p. 204).

I have a fair series of eggs in my collection including some of those taken both by Mr. Osmaston and Mr. Whistler and I find that these vary a great deal more in ground colour than may be gathered from the above descriptions. This varies from a cold green-grey to a rich buff. Other clutches have a greenish tint, pale greyish-stone colour or a buffy-stone colour of different depths ; in shape whilst none of my eggs are actually pyriform, all are distinctly pointed at the smaller end.

Twenty-five eggs average 37·0 by 26·3 mm. maxima *39·7* by 27·0 mm. and 38·1 by *27·1* mm. ; minima *35·4* by 26·0 and 36·3 by *35·1* mm. The eggs were taken on dates between the 2nd week in June and the 3rd week in July.

Habits.—Mr. Whistler thus describes the habits of this bird in the *Ibis.* 'The adults showed the usual habits of the genus on the breeding-ground, running swiftly from the intruder or flying round in circles, but they were less noisy than Common and Lesser Ring Plovers. The call-note is a soft 'twip'; the alarm-note may be described as a sort of chatter of two syllables 'Corrup,' not unlike the croak of a frog ; it is uttered usually on the wing, but also occasionally on the ground.'

'This handsome little Plover remains but a short time on its breeding-ground. At Karachi, where it is the most abundant of the waders, Ticehurst has recorded that the birds leave gradually and not in a body but that they are all gone by the end of May. This departure, however, does not take place till the breeding plumage is assumed, and it is so delayed that the male organs are enlarged practically to breeding size, while courting and pairing take place on the Karachi sands. They return there early in August and are abundant by the middle of the month. This account agrees with the published records regarding Ladakh, Tibet, and Turkestan which mostly refer to June and July. Presumably therefore only one brood is produced in the year. I can find no evidence contrary to my belief that this species passes from the Karachi coasts and the Bay of Bengal to its breeding-grounds in one sustained flight.'

Osmaston describes the note as a vibrating call reminding one of that of the Jungle Nightjar. With this exception, the habits and actions of the bird generally are very like those of the different species of *Charadrius*. During the breeding season they are said to be comparatively tame and to return soon to their nests when disturbed ; but in India during the cold weather where they collect in flocks, they are often wild and hard to approach.

CIRREPEDESMUS LESCHENAULTII.

The Large Sand-Plover.

Charadrius leschenaultii Lesson, Dict. Sci. Nat., xlii, p. 36 (1826) (Pondicherry, India).

Charadrius geoffroyi Blanf. and Oates, iv, p. 237.

Vernacular Names.—None recorded.

Description.—A much bigger bird than the Lesser Sand-Plover; also differing in having a white forehead, less rufous on the breast and flanks and a more rufous sandy tinge to the upper parts.

Colours of soft parts as in the Lesser Sand-Plover.

Measurements. Wing 128 to 140 mm.; tail 50 to 57 mm.; tarsus about 35 to 38 mm.; culmen 23 to 25 mm.

Distribution.—Found during the breeding season in Japan, Corea, Formosa, Hainan and possibly North-east China. In winter South to Australia and West to Eastern Africa.

Nidification.—Unknown.

Habits.—The same as those of the preceding bird.

(To be continued)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART XIV

(Continued from page 637 *of this volume).*

STERCULIACEÆ (Cke. i, 121).

Genera 48, species 660.—Chiefly tropical.

Cooke has 9 indigenous and 3 introduced genera. Of the former *Sterculia* is being split up into *Sterculia*, *Pterygota* and *Firmiana*; *Waltheria* has been transferred in a previous issue to the family *Bombacaceæ*. *Pentapetes* and *Buettneria* are here treated as indigenous genera.

To the introduced genera I add ; *Dombeya* and *Theobroma*..

Key :

A. Flowers unisexual. No petals.
  I. Leaves without peltate scales. Fruit follicular.
    1. Follicles woody or coriaceous
      (*a*) Seeds not winged ... ... 1. *Sterculia.*
      (*b*) Seeds winged ... ... 2. *Pterygota.*
    2. Follicles membranous ... ... 3. *Firmiana.*
  II. Leaves clothed beneath with peltate hairs. Fruit indehiscent ... ... 4. *Heritiera.*

B. Flowers bisexual. Petals present.
  I. Andrœcium columnar below, dilated above into a cup on the margin of which are placed the anthers usually alternating with staminodes
    1. Fruit a membranous inflated capsule ... 5. *Kleinhovia.*
    2. Fruit of straight or spirally twisted follicles ... ... 6. *Helicteres.*
    3. Fruit a woody loculicidal 5-valved capsule ... ... 7. *Pterospermum.*
  II. Andrœcium tubular, conical, antheriferous for nearly its whole length. No staminodes ... ... 8. *Eriolaena.*
  III. Andrœcium tubular, antheriferous at the margin. Anthers solitary or in groups alternating with staminodes
    1. Bracteoles caducous. Anthers 10–15.
      (*a*) Leaves cordate ... ... * 9. *Dombeya.*
      (*b*) Leaves tapering from the truncate base ... ... 10. *Pentapetes.*
    2. Bracteoles persistent. Anthers 5 ... 11. *Melhania.*
  IV. Andrœcium tubular at the base only. Stamens 5. No staminodes ... 12. *Melochia.*
  V. Andrœcium tubular. Anthers marginal, solitary or in groups between the staminodes.
    1. A herb ... ... 13. *Buettneria*

2. Trees or shrubs.
    (*a*) Capsule membranous, 5-angled, 5-winged ... ...*14. *Abroma.*
    (*b*) Capsule woody globular or oblong, 12-25 mm. long ... ...*15. *Guazuma.*
    (*c*) Fruit hard, leathery, up to 30 cm. by 10 cm. ... ...*16. *Theobroma.*

1. STERCULIA, Linn. (Cke. i, 122).

Over 100 species.—Tropics.

Cooke has 6 indigenous and 2 introduced species. Of the former *S. colorata*, Roxb. will be transferred to the genus *Firmiana* and *S. alata* Roxb. to the genus *Pterygota*.

I. Leaves digitate with 7–9 leaflets ... ... 1. *S. fœtida.*
II. Leaves palmately lobed
    1. Calyx yellow, pubescent within ... 2. *S. urens.*
    2. Calyx pink, glabrous within ... 3. *S. villosa.*
III. Leaves undivided
    1 Leaves pnninerved ... ... 4. *S. guttata.*
    2. Leaves palmately 7-ribbed... ... 5. *S. populnifolia.*
IV. Leaves undivided or more or less 3-5-lobed ... 6. *S. campanulata.*

1. **Sterculia fœtida,** Linn. Sp. Pl. (1753), 1008 ; Cke. i, 123.

Table 364 of Wight Ic. mentioned by Cooke should be omitted.

Distribution : Konkan, forests of the W. coast of the Madras Pres. at low elevations, Upper Tenasserim, Martaban, Malay Peninsula, Ceylon, E. tropical Africa, Moluccas, Philippines, N. Australia.

2. **Sterculia urens,** Roxb. Cor. Pl. i, (1795), 25, t. 24 ; Cke. i, 123.

Distribution : Gujarat, Konkan, Deccan, Kanara, S. M. Country, dry forests of Madras Pres., Rajputana, Northern and Central India, Chota Nagpur, Burma, Ceylon.

3. **Sterculia villosa,** Roxb. Hort. Beng. (1814), 50 ; Cke. i, 124.

Distribution : Common in deciduous forests throughout the greater part of India and Burma.

4. **Sterculia guttata,** Roxb. Hort. Beng. (1814), 50 ; Cke. i, 124.

Add : Wight Ic. t. 487.

Distribution : Ghats of the W. Peninsula from the Konkan to Malabar, Bellary.

5. **Sterculia populifolia,** Roxb. Hort Beng. 50 ; Fl. Ind. iii, 148 ; Gamble Madras Fl. 106.—*S. populifolia*, W. & A Prodr. i, 62 ; Masters in Hook. f. F.B.I.I, 361.—*Hildegardia populifolia*, Br. in Benn. Pl. Jav. Rar. 235.

Description : A small tree ; bark smooth ; young branches angular, resembling those of a poplar. Leaves 7.5–10 by 10 cm., 7-nerved, glabrous, rounded, cordate, acuminate ; petiole 5-15 cm. Panicles axillary and terminal, shorter than the leaves ; branches angular, glabrous, spreading ; ultimate pedicels shorter than the flowers. Flower-buds oblong. Segments of calyx 6 mm., free nearly to the base, linear-spathulate, downy externally. Ovary hispid. ovoid, tapering into a short style ; stigma 5-lobed. Follicle solitary, membranous, ovate, ventricose, terminated by a membranous, oblique, obtuse, cultriform wing. Seeds oblong, 2 cm. long, albuminous, radicle next the hilum.

Locality : Planted in the Bombay Presidency.

Distribution : Deccan Hills and E. Ghats of Madras Pres.

6. **Sterculia campanulata,** Wall. ex Mast. in Hook. f. F.B.I. i, 362 ; Kurz For. Fl. Burma i, 139.—*Pterocymbium javanicum*, Br. in Benn. Pl. Jav. Rar. (1844), 219, t. 45.

Description : A tree, 15–20 m. high, the young parts more or less tomentose ; bark smooth, grey. Leaves 10 by 9 cm., ovate to oblong, cordate, glabrous above, pubescent beneath, 5-nerved, entire or more or less 3–5-lobed, with the lobes blunt, more or less acute ; petiole 3·5-5 cm. long, puberulous ; stipules 6 mm. long, subulate, caducous. Panicles terminal, ascending, shorter than the leaf ; pedicels jointed. Bracteoles caducous. Calyx bell-shaped, pruinose, 5-lobed, the lobes oblong, acute, velvety along the border. Staanmil column pubescent below. Ovaries 5, sessile, gibbous at the apex ;

styles short, cohering ; stigmas filiform, recurved ; ovules 2, collateral, erect, anatropous. Follicles 5–6 or fewer by abortion, stipitate, glabrous. Seed solitary at the base of the follicle, puberulous.

Locality : W. Ghats : Planted at Khandala.

Distribution : Tropical forests along the eastern slopes of the Pegu Yoma and Martaban, Andamans, Nicobars, Siam, Perak, Perlis, Cochin-China, Malay Archipelago, Philippines.

2. PTERYGOTA, Schott & Endl.

Trees. Leaves undivided. Flowers in panicles from the axils of fallen leaves, 1-sexual or polygamous. Calyx deeply 5-partite. Petals 0. Staminal column cylindric, bearing 4–5 phalanges of about 5 anthers each in male flowers, and staminodes round the base of the ovary in female flowers. Ovary of 5 sessile carpels ; ovules many ; styles short, recurved ; stigma 2-lobed. Fruit of 5 large globose or obovoid follicles hard and woody, opening when ripe with 1 valve only. Seeds about 40, with an oblong-obovate wing attached to the margin of the valve; albumen adhering to the cotyledons ; radicle small, superior.

Species 4.—Tropics of the Old World, one in the Bombay Presidency.

1. **Pterygota alata,** R. Br. in Benn. Pl. Jav. Rar. (1844), 234 ; Gamble Fl. Madras 1011 —*Sterculia alata*, Roxb. Hort. Beng. (1814), 50 ; Pl. Coro. iii, 84, t. 287 ; Cke. i, 125.—*Pterygota Roxburghii*, Schott & Endl. Melet. (1832), 32.—*S. Heynei*, Bedd. Fl. Sylv. t. 320.

Description : Cke. i, 125.

Locality : N. Kanara : Near Barboli in evergreen rain-forests ; Sirsi Taluka near Londa about 2,000 ft. alt. (Talbot).—Planted at Khandala and Poona.

Distribution : Silhet, Chittagong, Pegu, Andamans, W. Ghats in evergreen forests from N. Kanara to Tinnevelly up to 3,000 ft.

3. FIRMIANA, Marsigli.

Trees ; leaves palmately lobed. Flowers in terminal panicles. Calyx tubular, covered with stellate tomentum, lobes short. Petals 0. Staminal column slender, with about 30 sessile anthers. Ovary of 5 carpels ; carpels 2-ovuled ; styles short, recurved ; stigmas acute. Fruit of 5 stipitate membranous follicles, opening before maturity. Seeds usually 2, one adhering to each margin of the open follicle, ovoid, smooth ; embryo transverse, radicle inferior.

Species 10 ; one in the Bombay Presidency.

1. **Firmiana colorata,** Br. in Benn. Pl. Jav. Rar. (1844), 235 ; Gamble Fl. Madras 107.—*Sterculia colorata*, Roxb. Hort. Beng. (1814), 50 ; Cke i, 125 ; Talb. For. Fl. Bomb. i, 140, fig. 85.

Description : Cke. i, 125.

Locality : Add : *Konkan :* Mulland, Salsette (McCann !), *W. Ghats :* Khandala (Blatter !), *Khandesh :* Satpuras (Blatter & McCann !).

Distribution : Mt. Abu, deciduous forests throughout the Bombay Pres., W. Ghats forests from S. Kanara to Travancore, Ceylon, Deccan, N. Circars, E. Bengal, Pegu, Indo-China, Siam.

4. HERITIERA, Ait. ; Cke. i, 126.

5. KLEINHOVIA, Linn. ; Cke. i, 127.

1. **Kleinhovia, Hospita,** Linn. Sp. Pl. ed. 2 (1763), 1365 ; Cke. i, 127.

Corolla rose-coloured, except the tips of two petals which are yellow. Capsule deeply 5-lobed.

Not indigenous in the Bombay Presidency.

6. HELICTERES, Pluk. ex Linn.; Cke. i, 127.

Species 45. Tropics of both hemispheres.

1. **Helicteres Isora,** Linn. Sp Pl. (1753), 963 ; Wight Ic. t. 180 ; Talb. For. Fl. Bomb. i, 146, fig. 89 ; Cke. i, 128.

Locality : Add : *Konkan :* Bombay (Blatter !) Salsette, Common (McCann !), *W. Ghats :* Khandala (Blatter !).

Distribution : From the Punjab and Bengal to Ceylon, Burma, Malaya, Australia, W. Indies.

7. PTEROSPERMUM, Schreb.; Cke. i, 128.

Species 20. Tropical Asia.

Cooke describes four species: *P. suberifolium*, *P. acerifolium*, *P. reticulatum*, *P. Heyneanum*.

Talbot [For. Fl. Bomb. i, (1909], 150) has united *P. reticulatum* with *Heyneanum* under the older name *P. Heyneanum*, Wall.

I cannot follow Talbot's opinion, but I shall exclude *P. Heyneanum* from the Bombay flora.

1. **Pterospermum suberifolium**, Lam. Tab. Encyc. et Method. III (1823), 156, t. 576; Cke. i, 129. *Pentapetes suberifolia*, Linn. Sp. Pl. 698.

Distribution: N. Circars in Ganjam. Deccan in Mysore, Coimbatore, Cuddapah and N. Arcot, up to 3,000 ft, Nellore Coast. There is no evidence to show that it grows wild in the Bombay Pres.

2. **Pterospermum acerifolium**, Willd. Sp. Pl. iii, (1800), 729; Masters in Hook. f. F.B.I. i, 368 (*excl. P. aceroides*, Wall.); Cke. i, 129.

Locality: N. Kanara: Devimane forests (Talbot). Planted elsewhere.

Distribution: Sub-Himalayan tract and outer Himalayan valleys and hills up to 4,000 ft., Bengal, Chittagong, Khasia Hills, Manipur, Tenasserim, Burma, N. Kanara, Siam.

3. **Pterospermum reticulatum**, Wight and Arn. Prodr. 69; Cke. i, 130.—*P. Heyneanum*, Talb. For. Fl. Bomb. i, 150 (*partim*) fig. 91.

Description: Cke. i, 130.

Locality: Konkan along the Ghats in moist evergreen rain-forests. *N. Kanara:* Sirsi and Siddapur talukas (Talbot).

Distribution: Malabar and Tranvancore in evergreen forests at low elevations.

Note: That *Pterospermum Heyneanum* is a species distinct from *P. reticulatum* is evident from the following table:

P. reticulatum	*P. Heyneanum*
Leaves very oblique at base.	Leaves much less or not at all oblique.
Stipules smaller.	Stipules ensiform, 12 mm. long.
Flowers 3–4·5 cm. across.	Flowers up to 8·5 cm. across.
Involucral bracts pinnatisect with filiform segments.	Involucral bracts foliaceous, deeply and variously cut and gashed.
Calyx 2·5–3·7 cm.	Calyx 5–6·2 cm. long.
Capsule 7·5 cm. long, obtusely angled, acute.	Capsule 5 cm. long, obtusely 5-angled.
Cells of capsule 4–seeded.	Cells of capsule 8–10-seeded.

P. Heyneanum does not seem to occur in the Bombay Presidency. In the Madras Presidency, the tree has been found only in the forests of N. Circars and Deccan from Ganjam to Cuddapah and Chingleput (Gamble).

8. ERIOLÆNA, DC. (Cke. i, 130).

Species about 8.—Indo-Malayan.

Cooke describes 4 species as occurring in the Bombay Presidency: *E. Stocksii*, *E. Hookeriana*, *E. Candollei*, and *E. quinquelocularis*.

Talbot (For. Fl. Bom. i (1909) 152) says: 'I am unable to satisfactorily distinguish between the 4 usually accepted species . . . . . which are founded I think on no constant differentiating characters of importance.'

Graham (Cat. Bomb. Pl. p. 20) mentions only *E. Hookeriana* and thinks it might be identical with *E. Candollei*.

Dalzell and Gibson (Bombay Fl. p. 24) give only *E. Candollei*.

Beddome (Fl. Sylvat. p. 50) distinguishes 2 species: *E Hookeriana* and *E. quinquelocularis*, and this he did, as Talbot thinks, on slender grounds.

Gamble (Madras Fl. p. 100) retains the same 2 species and adds a third-one: *E. Lushingtonii* Dunn which (in Kew Bull. (1915), 88) is considered as '*E. quinqueloculari, Wight, affinis, foliis membranaceis, alabastris medio constrictis distincta.*'

Brandis (For. Fl. N.-W. & Cent. Ind. (1874), 36) describes only *E. Hookeriana* and adds; 'I am inclined to think that the differences between

E. Hookeriana, *E. flavescens*, Garcke [= *E. quinquelocularis*], and *E. Stocksii* are not very great.'—But in his Indian Trees (1911) p. 87 he retains all the 4 species mentioned by Cooke, observing, however, that *E. Stocksii* is closely allied to and perhaps not specifically distinct from *E. Hookeriana*.

Let us examine the single species :

1. **Eriolæna Stocksii**, Hook. f. & Th. in Hook. f. F.B I. i, (1874), 370, Cke. i, (1901), 131; Brandis Ind. Trees (1911), 87; Haines Bot. Bih. & Or. (1921), 81

Cooke says that there are two good specimens of this species in the Kew Herbarium. But there is no fruit on either and thus Cooke was unable to decide whether *E. Stocksii* should be maintained as a separate species or united with *Hookeriana*. This seems to show that Cooke would have united *E. Stocksii* with *E. Hookeriana* but for the absence of the fruit in the Kew specimens. In other words we shall never be able to find out whether *E. Stocksii* is a distinct species till we see the fruit. It is over 80 years since Stocks collected in the Konkan and no botanist has in the meantime gathered a specimen showing the characters of leaf and flower given for *E. Stocksii* but with a fruit different from that of *E. Hookeriana*.

But what about the specimens mentioned by Brandis as originating from the Aravalli hills and the Panch Mahals (l. c.) ? They were either in fruit or not. If they were, how could Brandis identify the plant with *E. Stocksii*, as the fruit of this species is not known ? If they bore no fruit then there was no possibility of identifying them with *E. Hookeriana*.

The same difficulty is felt with regard to two specimens put under *E. Stocksii* by Haines (l.c.). He remarks : ' The specimens appear to be distinguished from *E. Hookeriana*, W. & A., by the very narrowly ovoid buds, much longer than the laciniate bracteoles, and by the stellate tomentum on the underside of leaves being thinner. It seems to me a variety of *E. Hookeriana* '.

Considering all this I think the best thing to do is, not to unite *E. Stocksii* with *E. Hookeriana*, but to drop it entirely.

As to the other 3 species I think we have sufficient reasons for considering them as distinct species.

2. **Eriolæna Hookeriana**, Wight & Arn. Prodr. (1834), 70; Grah. Cat. p. 20; Mast. in Hook. f. F.B.I. i. (1874), 370; Brandis For. Fl. N. W. & Centr. India (1874), 36; Ind. Trees (1911), 87; Cke. i, (1901), 131; Gamble Madras Fl. (1915), 110; Haines Bot. Bih. & Or. (1921), 81.

Description : Cke. i, 131.

This species can be distinguished from *E. Candollei* by the hairy style, by the shorter capsule with the valves tubercled and not keeled.

Locality : Along the S. Ghats, Konkan and dry forests of the Satpuras (Talbot).

Distribution : Bihar and Orissa : Hill tracts south of the Ganges from Shahabad and the Santal Parganas to Sambalpur and Angul (Haines). Madras Pres. : E. Ghats from Ganjam to Godavari, hill forests of the Deccan and Carnatic, up to 5,000 ft. in Cuddapah ; W. Ghats in the Pulney Hills (Gamble).

3. **Eriolæna Candollei**, Wall. Pl. As. Rar. i, (1830), 51, t. 64; Dalz. & Gibs. 24; Mast. in Hook. f. F.B.I. i, (1874), 370; Cke. i, (1901), 131; Brandis Ind. Trees (1911), 87; Kurz For. Fl. Burma i, (1877), 148.

Description : Cke. i, 131.

Locality : Add : *W. Ghats :* Khandala (Blatter !).

Distribution : Konkan, S. M. Country, N. Kanara, Bhutan, Burma, Siam, Laos, Tonkin, Yunnan.

4. **Eriolæna quinquelocularis**, Wight Ic. iii, (1847), 7 *ubi describ. tab.* 882, (*Microchloena quinquelocularis*, Wight l. c. 882) ; Bedd. For. Man. in Fl. Sylv. p. xxxv. t. 5, fig. 2 ; Cke. 1, (1901) 132 ; Brandis Ind. Trees (1911), 87 ; Gamble Fl. Madras (1915), 110 ; Haines Bot. Bih. & Or. (1921), 81.

Description : Cke. i, 132.

According to Haines this species can easily be distinguished from E. *Hookeriana* ' by the slender 2-5-flowered peduncles, and minute very caducous, entire or only lobed bracteoles, and in fruit by the less tubercled narrow capsules, 1–1·25″ long, lanceolate in outline and sharply pointed. In leaf it is very similar, but the under surface is white and more thinly stellate and the petioles relatively longer, being often as long as the blade.'

Distribution : Bombay Pres. : Konkan, W. Ghats, Deccan, S. M. Country.—*Madras Pres :* Deccan, Sandur Hills of Bellary, hills of Coimbatore, W. Ghats from Mysore to Travancore at 2,000 – 4,000 ft. (Gamble). Bihar.

* 9. DOMBEYA, Cav. (not in Cke.)

Shrubs. Leaves often cordate, palmately nerved, frequently lobed. Flowers rosy or white, numerous, in loose axillary or terminal cymes, in umbels or crowded into dense heads. Bracts 3, unilateral, caducous. Calyx 5 partite; lobes lanceolate, reflexed in flower, persistent. Petals 5, oblique, cuneate-obovate, marcescent. Stamens 15–20, 5 sterile, the remainder shorter, united into a tube or cup. Ovary 2–5-celled; ovules 2–3 in each cell. Styles free or connate; stigmas 5. Fruit a loculicidal capsule.

Species probably about 100. Africa, Madagascar, Seychelles. 3 species are cultivated in Bombay gardens.

1. Flowers in 2 parted cymes............................*1. *D. acutangula.*
2. Flowers in many-flowered much branched axillary and terminal cymes........................*2. *D. spectabilis.*
3. Flowers in 4–8 flowered umbels........................*3. *D. natalensis.*

*1. **Dombeya acutangula**, Cav. Diss. (1787), 123, t. 38, f. 2.

Description : A low tree or shrub. Leaves crowded at the ends of the branches. Leaves 7·5–10 cm. diam., thin, round cordate, clothed or both sides with short stellate hairs or nearly glabrous, shallowly 3–5 lobed or entire, petiole 5–7·5 cm. long. Flowers white or reddish, in many flowered 2 parted cymes; bracteoles large, ovate, caducous. Peduncles as long as the petioles, villous; pedicels about 12 mm. long, villous. Sepals 8 mm. long or less, reflexing. Petals 10–12 mm. long, oblique-obovate. Stamens 18, exceeded by the staminodes; filaments united at the base only. Ovary densely tomentose; styles free at the tips only.

Distribution : Mauritius, Bourbon.

* 2. **Dombeya spectabilis**, Bojer in Ann. Sc. Nat. ser. ii, 18 (1842) 191.

Description : A small tree. Leaves cordate, orbicular or oblong, acute, undulate, 5–9-nerved, rough above and rusty or whitish pubescent beneath; petioles downy. Flowers 2 cm. across, white, in many-flowered much-branched axillary and terminal cymes. Sepals lanceolate, shorter than the corolla. Petals roundish. Stamens united only at the base.

Distribution : E. tropical Africa.

* 3. **Dombeya natalensis**, Sond. in Linnæa 23 (1850) 17.

Description : Foliage poplar-like. Leaves cordate, acute, long-petioled, somewhat angular, toothed, with minute stellate pubescence, 5–7-veined. Involucre of narrowly awl-shaped leaflets. Umbels 4–8-flowered. Flowers pure white, large, sweet-scented.

Distribution : Natal.

10. PENTAPETES, Linn.

Herbs with hastate-lanceolate leaves. Flowers axillary with 3 caducous bracteoles. Sepals 5, lanceolate, persistent, connate at base. Petals 5. Stamens 20, in 5 groups of 3 each, alternating with 5 staminodes, which are nearly as long as the petals. Anthers 2-celled, extrorse. Ovary 3–5-celled, cells many-ovuled; style entire, twisted, thickened upwards, stigmas 5, minute. Capsule loculicidal. Seeds 8–12, 2-seriate in each cell, not winged. Cotyledons plaited, 2-partite.

Species 1. Indo-Malayan.

1. **Pentapetes phœnicea**, Linn. Sp. Pl. (1753), 698; Cke. i, 136.

Description: A pretty branched herb, 0·6–1·5 m. high, glabrous or with a few scattered stellate hairs. Leaves long, lanceolate, sharply toothed or crenate-serrate, 7·5–13 cm. long, with only 1 primary nerve. Flowers large, red, nodding on short 2-flowered peduncles. Sepals stellate and bristly. Capsule subglobose, bristly, axis woolly. Seeds subglobose, dotted.

Locality : Gujarat : Ghadi (Saxton & Sedgwick).—Cultivated in Sind.

Distribution : Indigenous in N.-W. India and Bengal.

11. MELHANIA, Forsk. (Cke. i, 133).

Species 45.—Africa, warmer parts of Asia and tropical Australia.

Cooke mentions 4 species : *M. incana*, *M. abyssinica*, *M. tomentosa*, and *M. Denhamii*. Of these *M. tomentosa*, Stocks has been united by Parker with *M. futteyporensis*, Munro.

1. **Melhania incana,** Heyne in Wall. Cat. (1828), 1200 ; Mast. in Hook. f. F.B.I. i (1874), 372 ; Cke. i, (1901), 133.

Distribution : S. M. Country of Bombay Pres. ; Madras Pres. : Deccan, Cuddapah, Coimbatore.

2. **Melhania abyssinica,** A. Rich. Fl. Abyss. i, (1847), 76 ; Mast. in Oliv. Fl. Trop. Afr. i, (1868), 231 ; in Hook. f. F. B. I. i, (1874), 372 ; Cke. i, (1901), 133 ; Blatt. Fl. Arab. in Rec. Bot. Surv. India viii, pt. i, (1919), 86.—M. ovata, Boiss. Fl. Or. I, 841 (*excl. syn.*).

Distribution : Sind, Arabia, Abyssinia, Cape Verde Islands.

3. **Melhania futteyporensis,** Munro ex Mast. in Hook. f. F. B. I. i, (1874), 373 ; Parker For. Fl. Punj. (1918), 47.—*M. Hamiltoniana*, Munro Hort. Agrens, 9 (*non* Wall.).—*M. tomentosa*, Stocks ex Mast. in Hook. f. F. B. I. i, (1874), 373 ; Cke. I (1911), 133.—*M. abutiloides*, Aitch. (*non* Arn.).

The reason why Parker has united *M. tomentosa* with *M. futtyporensis* is because the distinction between the two is based on the bracteoles alone. The bracteoles, however, vary considerably and cannot, therefore, form a reliable basis for classification. The following description is taken from Parker (l. c.): ' A cano-pubescent undershrub 2–3 feet high. Leaves 2–3 inches long, oblong, oblong-lanceolate or sometimes ovate, slightly cordate or rounded at the base, usually rather thick, softly tomentose on both surfaces especially the lower ; petiole 1 inch long or less ; stipules setaceous, about as long as the petioles. Peduncles axillary and terminal, 2-4-flowered. Bracteoles very variable, cordate-ovate to lanceolate, the edges recurved or not, equalling or shorter than the calyx. Sepals lanceolate, acuminate, villous outside. Petals exceeding the sepals, ·5 inch long or more, yellow. Capsule ·5 in long, ovoid, villous.'

Distribution : Gujarat, Sind, Rajputana Desert, dry hills of the Punjab, Trans-Indus, Central Provinces.

4. **Melhania Denhami,** R. Br. in Denh. & Clapp. Trav. (1826) App, 232 ; Cke. i, (1901), 132.—For synonyms see Blatt. Fl. Arab. in Rec. Bot. Surv. Ind. viii, pt. i, (1919), 86.

Locality : Add : *Cutch* (Blatter !).

Distribution : Rajputana Desert, Cutch, Sind, Baluchistan, Arabia, tropical Africa.

12. MELOCHIA, Linn. (Cke. i, 134).

Species about 65. Tropics.

Only 2 species are known from the Presidency : *M chorchorifolia* and *M. velutina*. The latter should, according to Stapf (Kew Bull. (1913), 317), be changed into *M. umbellata*.

1. **Melochia corchorifolia,** Linn. Sp. Pl. (1753), 675 ; Cke. i, 135.

Locality : Cutch (Blatter !).—*Gujarat :* Godra (Cooke). Bombay Island (Blatter !). *N. Kanara* (Hohenacker).

Distribution : In most districts of the Madras Pres. ; hotter parts from Kumaon to Sikkim, Malay Peninsula and Ceylon.—Tropics generally.

Uses : Leaves eaten as a vegetable ; stem yields a fibre (Haines).

2. **Melochia umbellata,** Stapf in Kew Bull (1913), 317 ; Gamble Fl. Madras (1915), 110.—*Visenia umbellata*, Houtt. Handl. viii (1777), 309.—*Visenia umbellata*, Wight Ic. 509.—*V. indica*, Houtt. ex Miquel Fl. Ind. Bat. i, ii,

189.—*Melochia indica*, (Houtt.) A. Gray ex K. Schum. in Engl. Bot. Jahrb. xi (1888), 209.—*Melochia velutina*, Wall. ex Bedd. For. Man. in Fl. Sylv. (1871) p. xxxv, t. 5, fig. 3; Mast. in Hook. f. F. B. I. i, (1874), 374; Cke. i, (1901). 135.—*Melochia arborea*, Blanco Fl. Filip. ed. 1 (1837), 524.—*Ridleia tiliæfolia*, DC. Prodr. I, 491; Dalz. & Gibs. Bomb. Fl. 24.

Description : Cke. i, 135.

13. BUETTNERIA, Lœfl. (not in Cke.).

Herbs, shrubs or trees, often climbing and frequently prickly. Leaves often glabrous. Flowers minute, in much-branched axillary or terminal umbellate cymes. Sepals 5, connate below. Petals 5, claws concave, limb with a long strap-shaped 2-fid appendage. Stamens 10, connate below, bearing 5 stamens alternating with 5 staminodes. Ovary sessile with 5 two-ovuled cells; style entire or 5-fid. Capsule globose, spiny, with 5 one-seeded cells and 5 septicidally deciduous valves. Seeds axile, exalbuminous; cotyledons folded round the superior radicle; plumule lobed.

Species 60. Tropics. 1 species indigenous in the Bombay Presidency.

1. **Buettneria herbacea,** Roxb. Cor. Pl. i, t. 29; Wight Ic. t. 488; Dalz. and Gibs. Fl. Bomb. 23; Mast. in Hook. f. F.B.I. i, 376.

Description : A branched herb with a perennial woody rootstock. Leaves distant, ovate-lanceolate, acuminate, toothed, paler beneath, 2·5-6 cm. long, base cordate or rounded, 3–5-nerved; petiole 4 mm. long. Stipules linear, equalling the petiole. Flowers small, purplish, in axillary cymes. Sepals linear-lanceolate, reflexed. Petals with long slender tips and 2-fid appendages. Fertile filaments very short, staminodes ovate. Capsule softly spiny, 6 mm. diam.

Locality : *Konkan* : (Dalzell & Gibson).

Distribution : Orissa; Madras Pres.: N. Circars, Deccan and Carnatic.

* 14. ABROMA, Jacq.

Trees or shrubs. Leaves cordate, ovate-oblong, serrulate, sometimes angled. Peduncles opposite the leaves, few-flowered. Sepals 5, connate near base. Petals 5, purplish, concave below, prolonged above into a large spoon-shaped lamina. Staminal cup of 5 fertile and as many sterile divisions, fertile filaments opposite the petals, 3-antheriferous; anthers 2-lobed, lobes divergent. Staminodes longer than the fertile filaments, obtuse Ovary sessile, pyramidal, 5-lobed; cells many-ovuled; styles 5. Capsule membranous, 5-angled, 5-winged, truncate at apex, septicidally 5-valved, valves villous at the edges. Seeds many, albuminous; embryo straight, cotyledons flat, cordate; radicle next the hilum.

Species 10. Tropical Asia to Australia. One species cultivated in the Presidency.

* **Abroma augusta,** Linn. f. Suppl. (1781), 341 (*Ambroma*); Cke. i, 136. Abroma fastuosa, Gaertn. Fruct.

Description : A shrub or small tree with velvety branches. Leaves 10-15 cm. by 10-12 cm., repand-denticulate, base 3-7-nerved, upper smaller, narrower, entire, glabrescent above, tomentose below; petiole 12-25 mm. Stipules linear, deciduous. as long as the petiole. Peduncle about 4 cm. long, axillary. Flowers 5 cm. diam., dark red. Sepals 2·5 cm., lanceolate, free nearly to the base. Petals scarcely exceeding the sepals, imbricate in bud, deciduous. Capsule almost 4 cm. long, obpyramidal, finally glabrous, thrice as long as the persistent calyx. Seeds enveloped in light cotton wool.

Locality : Grown as an ormanemtal plant in the gardens.

Distribution : Indigenous or cultivated throughout the hotter parts of India, Java, Philippines, China.

* 15. GUAZUMA, Plum. ex Adans.

A tree. Leaves simple, tomentose. Flowers in axillary cymes. Sepals 5, connate below. Petals 5, concave at the base, prolonged above into 2 narrow strap-shaped processes. Stamens 10, connate below into a tube, divided above into 5 three-anthered filaments, alternating with 5 lanceolate staminodes.

Ovary sessile, 5-lobed, 5-celled ; styles more or less connate ; ovules many in each cell. Fruit globular, woody, tubercled, many-seeded. Seeds albuminous ; cotyledons folded.

Species 5. Tropical America.

One species cultivated and sometimes run wild in the neighbourhood of human habitations.

* 1. **Guazuma tomentosa,** H.B. & K. Nov. Gen. Pl. 5 (1821), 320 ; Cke. i, 136 ; Parker Fl. Punj. (1918), 48.

Description : Leaves 7–11 by 5 cm., oblong-ovate, obliquely cordate, acuminate, serrate, scabrid above, pubescent beneath, base 5–7-nerved. Flowers small, in axillary cymes, yellow. Sepals 5, at first spathaceous. Petals 5. Anthers 2-lobed ; lobes divergent. Capsule 12–25 mm. long, globose or oblong, 5-celled, woody, covered with blunt tubercles, black when ripe.

Distribution : Frequently cultivated. A native of tropical America.

* 16. THEOBROMA, Linn.

Usually small trees. Leaves large, entire, simple, thick and strongly nerved. Flowers small, sometimes borne laterally on the branches rather than in axils. Calyx deeply 5-parted or -lobed. Petals 5, mostly clawed or narrowed below. Fertile stamens 5, opposite the sepals. Ovary sessile, 5-celled, many-ovuled ; style filiform. Fruit a large woody drupe or pod. Seeds imbedded in pulp.

Species about 20.—Tropical America. One species sometimes grown in the Bombay Presidency.

* 1. **Theobroma Cacao,** Linn. Sp. Pl. (1753), 782.—The Common Cacao.

Description : A wide-branching evergreen tree, reaching 5-8 m. in height. Twigs pubescent. Leaves alternate, oblong-oval or elliptic-oblong, entire, short-petioled, the blade 15 cm. long more or less, rounded at the base, abruptly acuminate, with strong midrib and paired or somewhat alternate arching side veins. Flowers small, in fascicles directly on the bark of the trunk and main branches, about 2 cm. across when expanded. Pedicels slender, 12 mm. or more long. Calyx rose-coloured ; segments acuminate. Corolla yellowish ; petals with a stalk-like claw and expanded blade. Fruit 30 cm. long or shorter, mostly 10 cm. or less in diam., about 10-ribbed, red, yellow, purplish or brown, elliptic-ovoid, the rind thick, hard and leathery ; cells 5, each with 5-12 seeds in a row imbedded in a white or pinkish acid pulp.

Locality : Grown in some gardens.

Distribution : Apparently a native of Central and S. Africa.

TILIACEÆ.

1. GREWIA, Linn.

Species 150. Africa, Asia, Australia, especially tropics.

Cooke gives 17 species. Of these *G. umbellata*, Roxb. must be excluded from the Bombay Flora. It is a Malayan species occurring in the Malay Peninsula, Siam and Borneo, but has never been found in the ' Concan and Coromandel ' as stated by Masters in the Fl. Brit. Ind. i, 385.

In the same way *G. polygama*, Roxb. has to be removed as it has never been observed in W. or S. India.

Numerous changes in the nomenclature of other species have to be made :

G. columnaris, Sm. = *G. orientalis*, Linn.
G. orientalis, Wight & Arn. = *G. rhamnifolia*, Heyne.
G. populifolia, Vahl = *G. tenax*, Fiori.
G. salvifolia, Heyne = *G. Damine*, Gaertn.
G. pilosa. Cooke (non Lam.) = *G. flavescens*, Juss.
G. abutilifolia, Vent. = *G. aspera*, Roxb.

Key (after Cke.) :

A. Inflorescence terminal and axillary, sometimes extra-axillary. Flowers in umbellate cymes.

I. Erect shrub or small tree ... ... 1. *G. orientalis*.

II. Scandent shrubs
  1. Torus long. Drupe deeply lobed, purplish ... ... 2. *G. umbellifera.*
  2. Torus short. Drupe yellow, wrinkled ... 3. *G. rhamnifolia.*

B. Inflorescence leaf-opposed and axillary, sometimes extra-axillary
I. Leaves scabrous with stellate hairs ... 4. *G. heterotricha.*
II. Leaves glabrous or nearly so ... ... 5. *G. tenax.*

C. Inflorescence axillary, rarely extra-axillary
I. Leaves usually hoary, at least beneath
  1. Gland of petals minute or o ... 7. *G. orbiculata.*
  2. Gland of petals conspicuous
    (*a*) Leaves 3-nerved from the base ... 6. *G. Damine.*
    (*b*) Leaves 5-6-nerved from the base
      * Stipules leafy, auricled ... 8. *G. tiliæfolia.*
      ** Stipules linear-lanceolate ... *9. *G. asiatica.*
II. Leaves not hoary beneath
  1. Drupe with a crustaceous rind
    (*a*) Leaves ovate-oblong. Anthers hairy. 10. *G. flavescens.*
    (*b*) Leaves orbicular. Anthers glabrous. 11. *G. villosa.*
  2. Drupe fleshy
    (*a*) Flowers all bisexual.
      * A small tree. Leaves lanceolate. Drupe didymous ... ... 12. *G. lævigata.*
      ** A straggling shrub. Leaves roundish, irregularly toothed or lobed. Drupe 1-4-lobed ... ... 13. *G. aspera.*
    (*b*) Flowers polygamous ... ... 14. *G. hirsuta.*

D. Inflorescence terminal in panicled cymes. Flowers involucrate... ... ... 15. *G. Microcos.*

1. **Grewia orientalis,** Linn. Sp. Pl. (1753), 964 ; Vahl Symb. Bot. 1, 34 (*non* Mast. in Hook. f. F.B.I. i, 384).—*G. columnaris*, Sm. in Rees Cyclop. (1811), 17, n. 5 ; Wight Ic. t. 44 ; Grah. Cat. 21 ; Dalz. and Gibs. 26 ; Mast. in Hook. f. F.B.I. i, 383 ; Cke. i, 138 ; Talbot For. Fl. i, (1909), 157.—*G. bracteata*, Miq. ex Mast. in Hook. f. F.B.I. i, 383 (*non* Roth.).—*G. pilosa.* Wall. Cat. n. 1112, C, D, E, F (*non* Lam. *neque* Roxb.).—*G. carpinifolia*, Wall. Cat. n. 1093 (*non* Juss. *neque* Roth. et Roxb.).— *G. obtusa*, Wall. Cat. n. 1103 (*partim*).
Description : Cke. i, 138 under *G. columnaris.*
Locality : Konkan : We have only Graham's records : Malabar Hill in Bombay and Salsette.—*N. Kanara :* The specimens to which Cooke refers are, according to Talbot, somewhat imperfect and cannot with certainty be referred to this species.—I have not seen any specimens from the Presidency.
Distribution : Bengal, Carnatic from Chingleput to Tinnevelly and lower Travancore, Ceylon, E. tropical Africa, Java.

2. **Grewia umbellifera,** Bedd. For. Man. in Fl. Sylv. p. xxxvii ; Mast. in Hook. f. F.B.I. i, 393 ; Cke. i, 138 ; Talb. For. Fl. Bomb. i, (1909), 155, fig. 94 (*partim*).—*G. Ritchiei*, Mast. in Hook. f. F.B.I. i, 389.
G. heterotricha, Mast., given as a synonym by Talbot, is a distinct species. He finds it impossible to separate the two species by any constant specific character. It can be admitted that the differences between the two species are not very pronounced, but then we must also consider that so far nobody has seen the fruit of *G. heterotricha.* I think it, therefore, advisable not to reduce *G. heterotricha* in the meantime.
Description : Cke. i, 138.
Locality : Konkan (Ritchie).—*N. Kanara :* Yellapur and Gersoppa (Talbot) ; Castle Rock (Blatter !)
Distribution : Madras Pres. : W. Ghats in all the districts (Gamble).

3. **Grewia rhamnifolia,** Heyne in Roth. Nov. Sp. (1821), 244 ; Gamble Fl. Madras (1915), 117 ; Haines Bot. Bih. & Or. (1921), 88.—*G. orientalis*, Wight & Arn. Prodr. i (1834). 76 ; Dalz. & Gibs. Bomb. Fl. 26 ; Mast. in Hook. f.

F.B.I. i, 384 (*non* Linn.); Cke. i, 139 (*non* Linn.); Talb. For. Fl. Bomb. i, (1909), 157, fig. 95 (*non* Linn.).

Description : Cke. i, 139.

Locality : On the Southern Ghats (Dalzell & Gibson). This is the only record; but no botanist after Dalzell and Gibson has ever seen this plant. Its occurrence in the Bombay Presidency is very doubtful.

Distribution : Bihar and Orissa; Madras Pres.: N. Circars and Carnatic districts, extending to the E. Deccan; Mysore: Bababuden hills at 3,000 ft., Ceylon.

4. **Grewia heterotricha,** Mast. in Hook. f. F.B.I. i, 385; Cke. i, 139; Gamble Fl. Madras (1915), 117.—*G. umbellifera,* Talbot For. Fl. Bomb. i, (1909), 155 (*partim*).

Can be distinguished from *G. umbellifera* by the much larger buds, by the pedicels being few together, by the leaves being densely pubescent beneath and by the much shorter gonophore.

Description and *Locality :* Cke. i, 139, 140.

Distribution : N. Kanara; W. Ghats in S. Kanara, Coorg, Coimbatore and Nilgiri districts, at 3,000--6,000 ft. (Gamble).

5. **Grewia tenax,** Fiori Bos. Piante legn. Eritrea (1909), 246; Blatt. Fl. Arab. in Rec. Bot. Surv. Ind viii, pt. i, (1919), 88.—*Chadara tenax*, Forsk. Fl. Aeg.—Arab. (1775) p. cxiv and p. 105.—*Grewia chadara*, Lam. in Encycl. Meth. Bot. iii, (1789), 44.—*G. populifolia*, Vahl Symb. i, (1790), 33; DC. Prodr. i, (1824), 511; Boiss. Fl. Or. i, (1867), 843; Oliv. Fl. Trop. Afr. i, (1868), 246; Mast. in Hook. f. F.B.I. i (1874), 385; Cke. i, 140; Blatt. Fl. Aden (1915), 131.—*G. betulæfolia*, Juss. in Ann. Mus. Par. iv, (1804), 92, t. 4, f. 1; Gamble Fl. Madras (1915), 117.—*G. membranacea*, A. Rich. Fl. Abyss. i, (1847), 90.—*G. reticulata*, Hochst. ex Mast. in Oliv. Fl. Trop. Afr. i, 246.—*G. ribesiæfolia*, Hochst. ex Mast. l.c.

Description and *Locality :* Cke. i, 140.

Distribution : Punjab, Desert of W. Rajputana, Sind, Baluchistan, Cutch, S. M. Country, Deccan and Carnatic of Madras Pres., Ceylon, Afghanistan, Persia, Arabia, tropical Africa, Mauritius.

6. **Grewia Damine,** Gaertn. Fruct. ii, 113; Gamble Fl. Madras (1915), 118.—*G. salvifolia*, Heyne ex Roth Nov. Pl. Sp. (1821), 239 (*non* Linn. f. *nec* Roxb.); Mast. in Hook. f. F.B.I. i, 387 (*partim*).

Description : Cke. i, 140.

Distribution : Trans-Indus, Salt Range, Sind, Rajputana, S. M. Country, N. Circars, Deccan from Kistna to Bellary.—Ceylon.

7. **Grewia orbiculata,** Rottl. in Ges. Naturf. Fr. Neue Schr. 4 (1803), 205; Mast. in Hook. f. F.B.I. i, 386; Cke. i, 141; Talbot For. Fl. Bomb. i, 160.—*G. rotundifolia*, Juss. in Ann. Mus. Par. 4 (1804), 92, t. 50; Gamble Fl. Madras (1915), 118; Haines Bot. Bih. & Or. (1921), 92.

From the above synonymy I don't quite see why Gamble and Haines have adopted *G. rotundifolia*, Juss.

According to Talbot l.c. the figure of *G. rotundifolia* in Icones t. 45 appears to be a representation of *G. pilosa*, Lam.

Description : Cke. i, 141.

Locality : Deccan : Gokak hills (Ritchie).—Talbot's record from the Konkan has to be eliminated. He himself says l.c. that he is unacquainted with this species.

Distribution : Madras Pres. : N. Circars in Vizagapatam and Kistna, Deccan in Kurnool and Cuddapah, Carnatic, in S. Arcot and Tinnevelly (Gamble).

8. **Grewia tiliæfolia,** Vahl Symb. i, (1790), 35; Cke. i, 141.—*G. asiatica* var. *tiliæfolia*, Brandis Ind. Trees (1911), 98.

Locality : Add: *Khandesh :* Satpuras up to 4,000 ft. (McCann!); *W. Ghats :* Khandala (Blatter!); Panchgani (Fernandez!); Pasarni Ghat (Blatter!).

Distribution : Sub-Himalayan region from the Jumna to Nepal up to 4,000 ft., Central India, all districts of Madras Pres., Bihar and Orissa, Burma, Ceylon, E. tropical Africa.

Var. leptopetala, Cooke in Cke. Fl. Bomb. i, 142.—*Grewia leptopetala*, Brandis Ind. Trees (1906), 100.
Locality : Deccan : Hills near Poona (Brandis).

*9. **Grewia asiatica.** Linn. Mantiss. (1767), 122 (*non* Roxb.) ; Parker Fl. Punj. (1918), 55 : Haines Bot. Bih & Or. (1921), 94 ; Mast. in Hook. f. F.B.I. i, 389 (*excl. syn. subinaequalis*) ; Cke. i, 142 (*partim*).
Description : A shrub or small tree ; young parts stellately pubescent. Leaves 7–17 by 6–12 cm., ovate or suborbicular, acute or sub-acuminate or cuspidate, sharply and often coarsely doubly serrate, subglabrous above, hoary-tomentose beneath, rounded or only slightly cordate at the base 5–6–7-nerved ; petioles 6–12 mm. long, thickened at the top ; stipules nearly as long as the petioles, linear, subulate or lanceolate. Flower-buds broadly cylindric or clavate. Peduncles axillary, usually many, long and slender, far exceeding the petioles and often 3–4 times as long, sometimes 4 cm. long. Flowers large. Bracts beneath the pedicels lanceolate. Sepals about 10 mm. long, linear-oblong, acute, stellately pubescent or tomentose. Petals yellow, oblong or ovate-oblong, jagged or entire, about 6 mm. long, not bifid ; gland with a wide fleshy margin, pubescent towards the edges. Gonophore long. Stigma with 4 short, rounded lobes ; style much thickened above. Fruit red, globose, 6–8 mm. diam.; pyrenes 1–2, always one-celled only.
Locality : Extensively cultivated.
Distribution : In the wild state unknown.

10. **Grewia flavescens,** Juss. in Ann. Mus. Par. iv, (1804), 89 ; Gamble Fl. Madras (1915), 119 ; Haines Bot. Bih. & Or. (1921), 89.—*G carpinifolia*, Mast. in Hook. f. F.B.I., i, 387 (*non* Juss.).—G. pilosa, W. & A. (*non* Lam.).—*G. pilosa* Mast. in Hook. f. F.B.I. i, 388 (*partim, non* Lam.).
Locality : Add : *Khandesh :* Akrani at 3,700 ft. (Talbot).—*Konkan :* Uran (Hallberg !).—*Deccan :* Bijapur (Talbot).
Distribution : Arid subtropical belt of Asia, Africa, South and Central India to Senegambla (Drummond).

11. **Grewia villosa,** Willd. in Ges. Naturf. Fr. Neue Schr. 4 (1803), 205 ; DC. Prodr. i, 512 ; Wight & Arn. Prodr. i, 79 ; Mast. in Hook. f. F.B.I., i, 388 ; Cke. i, 143 ; Talbot For. Fl. Bomb. i, 163 ; Gamble Fl. Madras (1915), 119 ; Parker Fl. Punj. (1918), 54.—*G. orbiculata*, G. Don. Gen. Syst. i, 551 (*non* Rottl.).
Description : Cke. i, 143.
Locality : Add : *Deccan :* Gokak (Talbot).
Distribution : Trans-Indus, Punjab, Rajputana, Sind, Deccan and Carnatic of the Madras Pres. from the Kistna southwards.—Cape Verde Islands, tropical Africa.

12. **Grewia lævigata,** Vahl Symb. i (1790), 34 ; Mast. in Hook. f. F.B.I. i, 389 : Cke. i, 143 ; Talbot For. Fl. Bomb. i, 164, fig. 101.—*G. disperma*, Rottl. in Spreng. Syst. ii (1825), 579 ; Gamble Fl. Madras (1915), 118 ; Haines Bot. Bih & Or. (1921), 91.
Description : Cke. i, 143.—' Towards the base of the leaves the teeth are converted into small cup-shaped glands which appear to be characteristic.' (Parker).
Locality : Add : *Konkan :* Near village sites and in deciduous monsoon-forests (Talbot).—*W. Ghats :* Igatpuri (McCann !) ; Khandala (Blatter !); Lonavla (McCann !).
Distribution : Sub-Himalayan tract from the Ravi eastwards, Assam, Burma, Bihar and Orissa, Bombay Pres., Madras Pres., in all districts, Malay Archipelago, Australia, tropical Africa.

13. **Grewia aspera** Roxb. Hort. Beng. (1814), 42 ; Fl. Ind. ii, (1832), 591 ; Gamble Fl. Madras (1915), 119 ; Haines Bot. Bih. & Or. (1921), 89.—*G. abutilifolia*, Mast. in Hook. f. F B.I. i, 390 (*partim*) ; Williams Bull. Herb. Boiss. v. (1905), 29 (Juss ?) ; Cke. i, 144 ; Talbot For. Fl Bomb. i, 165.
Description : Cke. i, 144.
Locality : Add : *Konkan :* Salsette (McCann !).
Distribution : India, Burma, Cambodia, Malaya.

14. **Grewia hirsuta,** Vahl Symb. i, (1790), 34 (*non* Smith in Rees Cyclop.); Wight & Arn. Prodr. i, 78; Ic. 76; Mast. in Hook f. F.B.I. i, 391; Cke. i, 144; Gamble Fl. Madras (1915), 119; Haines Bot. Bih & Or. (1921), 90 (*partim*).—*G. tomentosa*, Roxb. Fl. Ind. ii, 589 *in adnot. sub* no. 13, *G. polygama;* (*non* Juss).
Description: Cke. i, 144.
Distribution: Sub-Himalayan tract from the Indus eastwards up to 4,000 ft., Chota Nagpur, N. Circars and Carnatic of Madras Pres., Konkan, Deccan, and S.M. Country of Bombay Pres., Burma, Ceylon, Laos, Siam, Cambodia, N. Australia.

15. **Grewia Microcos,** Linn. Syst. ed. 12, ii, (1767), 602; Mast. in Hook. f. F.B.I i, 392; Cke. i, 145. For synonyms see Mast. l. c.
Description: Cke. l. c.
Locality: Add: *Konkan:* Salsette (Blatter!).
Distribution: India, Burma, Assam, China, Malaya.

2. ERINOCARPUS, Nimmo.

Species 1.

1. **Erinocarpus Nimmonii,** Grah. Cat. Bomb. (1839), 21; Cke. i, 146.
Description: Cke. l. c.
Distribution: Endemic in the Presidency.

3. TRIUMFETTA, Linn. (Cke. i, 146).

Species 75.—Tropics.
Cooke has 3 species: *T. pilosa*, *T. rhomboidea*, *T. rotundifolia*. The name *T. pilosa* has to cede to *T. tomentosa*, Noronha, *T rhomboidea* is Linné's *T. Bartramia*. Two further species, new to the Presidency, are being added.

I. Fruit with bristles, 2·5 cm. across. Leaves ovate-oblong or ovate-acuminate or lanceolate-acuminate, softly tomentose or pubescent beneath ... ... 1. *T. tomentosa.*
II. Fruit with bristles 5-6 mm. across. Pericarp tomentose
  1. Fruit globose. Leaves tomentose beneath. Herbaceous undershrubs
    a. Lower leaves 3-5-lobed. Bristles of fruit glabrous. Stamens 8–15... ... 2. *T. Bartramia.*
    b. Lower leaves orbicular. Bristles of fruit puberulous. Stamens 15–25 ... 3. *T. rotundifolia.*
  2. Fruit ovoid. Bristles ciliate down one side. Stamens 5–13. Leaves subglabrous, irregularly bluntly dentate; lower ones ovate 3-lobed. Annual ... 4. *T. pentandra.*
III. Fruit with bristles 12 mm. across. glabrous. Leaves ovate-caudate, serrate, glabrous Annual... ... ... 5. *T. annua.*

1. **Triumfetta tomentosa,** Noronha in Verh. Batav. Gen. v, (1790), ed. i, Act. iv. 27.—*T. pilosa*, Roth Nov. Pl. Sp. (1821), 223; Wight & Arn. Prodr. i, 74; Mast. in Hook. f. F.B.I. i, 394; Cke. i, 147; Gamble Fl. Madras (1915), 120; Haines Bot. Bih. & Or. (1921), 85 (*erronee adscripta Roxburghio*).—*T. oblongata*, Link Enum. Pl. Hort. Berol. ii, 5.- *T. cana*, Blume Bijdr. i, (1825), 113; Mast. in Hook. f. F.B.I. i, 396.—*T. pseudocana*, Sprague & Craib in Kew Bull. (1911), 23; Ridley Fl. Malay Pen. i, (1922), 304. *T. tomentosa*, Bojer in Ann. Sc. Nat. ser. ii, xx, (1843), 103.—*T. tomentosa*, Telfair ex. Wall. Cat. n. 1080.

The above synonymy shows that *T. pilosa*, Roth, *T. cana*, Blume, *T. pseudocana*, Sprague & Craib, and *T. tomentosa*, Bojer have been united. As an explanation I refer to a passage by V. Narayanaswami in which Craib's Floræ Siamensis Enumeratio is reviewed (Journ. Ind. Bot. Soc. v, (1926), 33): 'on page 191 *Triumfetta cana* Masters in F.B.I. p. 396 *non* Bl. is, I think, a mistake; for *T. cana*, of F.B.I. by Masters is identical with *T. cana*, of Bl. Bij. i, 113. Because Masters' description of the capsular spines being straight ciliated is clearly an error in judgment as is shown on an examination of the sheets he quotes i.e., Hk. and Th.'s Khasia mountain specimen, which has the spines distinctly bent at the tip. On no sheet of *T. cana*, Bl. (Masters) in the Calcutta herbarium are the spines seen perfectly straight, but all are more or less bent, It is also considered that the change of *T. cana*, Mast. to *T. pseudocana* of Sprague and Craib is in the first instance unnecessary, and secondly according to specimens in Calcutta herbarium, *T. cana*, of Masters has been proved to be identical with *T. cana*, Bl. Further *T. cana*, Mast. is in no way distinct from *T. tomentosa* Boj. which is described as having straight transparent bristles but which actually is not so, as a close examination of all the sheets in Calc. Herbarium has shown that the transparent bristle tips in all cases are more or less bent and not straight. Hence instead of multiplying synonyms for one and the same species, it is convenient to have all these reduced to *T. pilosa* which is the earliest authentic name of the species and making *T. tomentosa* and *T. cana*, Mast. and Bl. as varietal forms only.'

I agree with Narayanaswami, excepting the last sentence, in which he says that *T. pilosa* is the earliest authentic name of the species. *T. tomentosa*, Noronha is older, going back to 1790, and that name, therefore, must be retained,

Locality: Add: *W. Ghats:* Khandala (Blatter and McCann !).

Distribution: Throughout tropical India, Burma, Malay Peninsula. Malay Archipelago, China, Ceylon, Abyssinia, W. tropical Africa, E. tropical Africa?

2. **Triumfetta Bartramia**, Linn. Syst. ed. 10 (1759), 1044; Roxb. Fl. Ind. ii, (1832), 463; Fawcett *et* Rendle in Journ. Bot. lix, 224.—*T. rhomboidea*, Jacq. Pl. Carib. (1760), 22, *nomen*, *et* Select. Stirp. Amer. (1763), 147, t. 90; DC. Prodr. i, 507; Mast. in Hook. f. F.B.I. i, 395; Cke. i, 147; *multi alii*.—*Bartramia indica*, Linn. Sp. Pl. i, (1753), 389.—*T. trilocularis*, Roxb. Fl. Ind. ii, (1832). 462.—*T. angulata*, Lam. Encycl. iii, 421.

In the above synonymy the earliest trivial name is '*indica*' but, as Craib points out, it 'cannot be used owing to the incompletely known *T. indica*, Lam.'

Locality: Add: *Konkan:* Bombay (Blatter !); Salsette (Hallberg !).—*W. Ghats:* Igatpuri (McCann !); Khandala (Blatter !).

Distribution: Tropical and subtropical India, Ceylon, Malay Peninsula, Malay Archipelago, China, Africa, America.

3. **Triumfetta rotundifolia**, Lam. Encyc. iii, (1789), 421; Mast. in Hook. f. F.B.I. i, 395; Cke. i, 148.

Locality: Add: *W. Khandesh* (Blatter & McCann !).

Distribution: South Punjab; Central India; Bombay Pres.: Gujarat, Khandesh, Deccan; Madras Pres.: in all districts of the Circars, Deccan and Carnatic; Mysore; Bihar; Burma.

4. **Triumfetta pentandra**, A. Rich. in Guill. & Per. Fl. Seneg. (1830-33), 93, t. 19; Gamble Fl. Madras (1915), 120.—*T. neglecta*, Wight & Arn. Prodr. i (1834), 75; Mast. in Hook. f. F.B.I. i, 396; Parker Fl. Punj. (1918), 56; Haines Bot. Bih. & Or. (1921), 85.

Locality: *W. Khandesh* (Blatter & McCann !).

Distribution: Punjab: W. to the Indus., Mt. Abu, Madras Pres.: E. coast of Guntur, Tinnevelly, Ceylon, Abyssinia, Senegal.

5. **Triumfetta annua**, Linn. Mant. i, (1767), 73; Mast. in Hook. f. F. B. I. i, 396; Gamble Fl. Madras (1915), 120; Haines Bot. Bih. & Or. (1921), 85.

Locality: *W. Ghats:* Khandala (Blatter !).

Distribution: Tropical Himalaya from Simla to Sikkim; Assam; Burma; Andamans; Deccan in Godaveri and Bellary; W. Ghats of Bombay Pres., S. Kanara and Coorg; Malay Archipelago; tropical Africa.

4. CORCHORUS, (Tourn.) Linn. (Cke. i, 149).

Species about 40.—Warm countries.

From the Bombay Presidency Cooke mentions 7 species, to which I add *C. urticæfolius* ; *C. antichorus* and *C. acutangulus* are being changed into *C. depressus* and *C. æstuans* respectively.

Key (chiefly after Gamble) :

A. Erect annuals or rarely becoming perennial and woody, but then always with pubescent capsules. Leaves ovate-lanceolate to oblong-lanceolate
  I. Capsule depressed-globose, ridged and muricate, 5-valved ; valves woody. Leaves straight-sided, serrate ... 1. *C. capsularis.*
  II. Capsule ending in a single beak, lobed at the summit
    1. Capsule 2·5–7·5 cm. long, ribbed or angled, glabrous or scabrid
      a. Capsule 10-ribbed, 5-valved, glabrous. Leaves ovate-lanceolate, finely crenate-serrate ... ... 2. *C. olitorius.*
      b. Capsule 3–4-angled, 3-4-valved, more or less pubescent
        * Leaves straight-sided, crenate-serrate ... ... 3. *C. trilocularis.*
        ** Capsule under 2·5 cm. long, Leaves ovate, serrate ... ... 8. *C. urticaefolius.*
    2. Capsule 12 mm. long, cylindric, pubescent, 3-valved. Leaves straight-sided, serrate ... ... 4. *C. fascicularis.*
  III. Capsule ending in 3 radiating points, 3–4-valved, 2·5–3·7 cm. long
    1. Capsule 6-angled, 3-winged. Leaves straight-sided, serrate ... ... 7. *C. æstuans.*
    2. Capsule cylindric, not winged. Leaves ovate, crenate-serrate ... ... 6. *C. tridens.*

B. Woody, prostrate undershrub. Leaves roundish. Capsule 1·2–3 cm. long, glabrous, cylindric, 4-valved ; beak entire ... 5. *C. depressus.*

1. **Corchorus capsularis,** Linn. Sp. Pl. (1753), 529 ; Mast. in Hook. f. F.B.I. i, 397 ; Cke. i, 148.

Distribution : May have beeen introduced from China or Cochin-China.

2. **Corchorus olitorius,** Linn. Sp. Pl. (1753), 529 ; Mast. in Hook. f. F.B.I, i, 397 ; Cke. i, 149.

Locality : Add : *W. Khandesh* (Blatter & McCann !). *Konkan* : Bombay (Blatter !) ; Salsette (McCann !).

3. **Corchorus trilocularis,** Linn. Mant. (1767), 77 ; Mast. in Hook. f. F.B.I. i, 397 ; Cke. i, 149.

Locality : Add : *Sind* : In many places (Sabnis !). *Cutch* (Blatter !). *Khandesh :* Bhusaval (Blatter & McCann !).

4. **Corchorus fascicularis,** Lam. Encycl. ii, (1786), 104 ; Mast. in Hook. f.F.B. I. i, 398 ; Cke. i, 149.

Locality : Add : *Sind* (Duthie). *Khandesh* (Blatter !). *Konkan* : Bombay (Blatter !) ; Salsette (McCann !).

Distribution. Throughout the hotter parts of India, Ceylon, tropical Africa, Australia.

5. **Corchorus depressus,** Stocks in Proc. Linn. Soc. i, (1848), 367.—*Antichorus depressus*, Linn. Mant. (1767), 64.—*Corchorus Antichorus*, Raeusch. Nom. Bot. ed. 3 (1797), 158 ; Cke. i, 150.—*Jussiæa edulis*, Forsk. Fl Aeg.-Arab.

(1775), 210.—*Corchorus microphyllus*, Fres. in Mus. Senckenb. ii, (1837), 156.—*C. humilis*, Munro ex Stocks in Proc. Linn. Soc. i, (1848), 367.

Locality : Add : *Sind* : In many places (Sabnis !).—*Cutch* (Blatter !).—*Kathiawar :* Dwarka (Borgesen) ; Rajkot (Blatter !).

Distribution ; Deccan, Gujarat, Cutch, Sind, Rajputana, Afghanistan, Arabia, N. Africa, Cape Verde Islands, tropical Africa.

6. **Corchorus tridens,** Linn. Mant. App. (1771), 566 ; Cke. i, 150.

Locality : Add : *Sind :* Thar and Parkar (Sabnis B 750 !).

Distribution : Rajputana Desert, Deccan and Carnatic of Madras Pres., ' Generally distributed ' (Masters). Afghanistan, tropical Africa.

7. **Corchorus æstuans,** Linn. Syst. ed. 10 (1759), 1079 (*non* Forsk.) ; Fawcett & Rendle in Journ. Bot. lix, 225.—*C, acutangulus*, Lam. Encycl. ii, (1786), 104 ; Mast. in Hook. f. F.B.I. i, 398 ; Cke. i, 150.

Description : Cke. i, 150.

Locality : Ldd : *Konkan :* Salsette (Blatter !).

Distribution : Hotter parts of India. Tropics generally.

8. **Corchorus urticæfolius,** Wight & Arn. i, (1834), 73 ; Mast. in Hook. f. F.B.I. i, 397 ; Gamble Fl. Madras (1915), 122.

Description : An annual herb. Leaves 5–7·5 by 2·5–4·5 cm., ovate, cordate, acuminate, serrate, sometimes oblique, thinly pilose. Peduncles extra-axillary, 2–3-flowered. Capsule elongated, under 2·5 cm. long, terete or slightly 3-angled, bent downwards, hairy, beaked ; beak erect, entire ; valves with transverse internal partitions.

Nearly related to *C. trilocularis*, but with a much shorter fruit.

Locality : Konkan : Bombay Isl. (Blatter !).

Distribution : Madras Pres. : dry districts of the Carnatic, Salem, Chingleput ; Ceylon, Burma, Abyssinia.

5. ELÆOCARPUS, Burm. ex Linn. (Cke. i, 151).

Species 90. Tropics.

Cooke has 6 species. Of these I omit *E. aristatus*, Roxb. and *E. Munroi*, Mast. for want of sufficient evidence of their occurrence in the Presidency.

1. **Elæocarpus Ganitrus,** Roxb. Hort. Beng. (1814), 42.

The presence of this species in the W. Ghats can scarcely be doubted, but judging from its distribution (Nepal, Bengal, Assam, Burma, Malay Peninsula) we are allowed to conclude that it is not indigenous in the Presidency. It does not occur in the Madras Presidency.

2. **Elæocarpus serratus,** Linn. Sp. Pl. (1753), 515 (*non* Roxb.). *E. cuneatus*, Wight Ill. i, 83.

Locality : N. Kanara.

Distribution : Madras Pres. : In all districts of the W. Ghats up to 5,000 ft. tropical Himalaya, Sikkim 2,000—3,000 ft., (not in Malay Peninsula), Ceylon.

3. **Elæocarpus oblongus,** Gaertn. Fruct. i, (1788), 202, t. 43 ; Wight Ic. t. 46.

Distribution : Madras Pres. : In all districts of the W. Ghats up to 6,000 ft Malaya.

4. **Elæocarpus tuberculatus** Roxb. Hort. Beng, (1814), 93.

Distribution : W. Ghats from N. Kanara southwards to Travancore, up to 5,000 ft., Burma, Malaya

LINACEÆ

Genera 9. Species 150.—Cosmopolitan.

1. LINUM, Tourn. ex Linn.

Species 90.—Temperate and subtropical, especially Mediterranean.

2. **Linum mysorense,** Heyne in Wall. Cat. (1828), 1507.

Locality : Add : *Konkan ;* Trombay (Blatter !).—*W. Ghats ;* Panchgani (Blatter !)

2. REINWARDTIA, Dum.

Species 1. India to China.
In the following *R. tetragyna*, Planch. is united with *R. trigyna*, Planch.

1. **Reinwardtia trigyna**, Planch. in Hook. Lond. Journ. Bot. vii, (1848), 522. —*R. indica*, Dum. Comm. Bot. (1822), 19.—*R. repens*, Planch. l. c. (1848), 523. —*R. tetragyna*, Planch. l. c. (1848), 523. *R. trigyna*, Dalz. & Gibs. Fl. Bomb. (1861), 16.—*Linum trigynum*, Roxb. in As. Res. vi, (1799), 357 (*non* Linn.); Roxb. Fl. Ind. ii, (1832), 110; Bot. Mag. t. 1100—*L. repens*, D. Don Prodr., Fl. Nep. (1825), 217.—*L. tetragynum*, Colebr. in Wall. Cat. 1506; Benth. in Bot., Reg. t. 1326.—*L. Cicanobum*, D. Don. l. c. 217.—*Macrolinum trigynum*, Reichb. Handb. (1827), 306.—*Kittelocharis trigyna*, Alef. in Bot. Zeit. (1863), 282.

I give Parker's description in his For. Fl. Punjab, 57, with a few changes.

Description : A glabrous shrub, 0·6–0·9 m. high, branches erect or prostrate and rooting. Leaves 2·5-10 cm. long, elliptic-lanceolate or oblanceolate, acute, decurrent into a short petiole, entire or minutely crenate-serrate, glabrous, mucronate, pale beneath; stipules minute, subulate, caducous. Flowers mostly solitary and axillary, yellow, showy, about 3·8 cm. across. Sepals 5, lanceolate, acute, 12·7–15 mm. long. Petals 5, contorted, obovate, cuneate, about 2·5 cm. long. Stamens 5, connate at the base, hypogynous, with as many interposed staminodes, in some flowers shorter, in others longer than the style. Glands 2–3 adnate to the staminal-tube. Ovary 3-5-celled, cells 2-locellate; ovules one in each locellus; styles normally 3, free or connate at the base, sometimes 4, 5 or 7 of different lengths. Capsule globose, the size of a pea, shorter than the persistent sepals.

Locality : Add : *Konkan :* Bombay (Blatter !); Penn (McCann !).—*W. Ghats :* Panchgani (Blatter !).

Distribution : Along the Himalaya from the Indus eastwards, Salt Range, Trans-Indus, Simla, Kumaon to Sikkim up to 6,000 ft. Assam, Chittagong, Bihar, Mt. Abu, Bombay Konkan and Ghats, W. Ghat forests of S. Kanara and Mysore, Tonkin, Siam, China.

3. HUGONIA, Linn.

Species 11.—Palæotropics.

1. **Hugonia Mystax**, Linn. Sp. Pl. (1753), 675.

Distribution : Konkan and N. Kanara of Bombay Pres.; throughout the dry forests of the Madras Pres., Ceylon.

MALPIGHIACEÆ

Genera 56. Species almost 800.—Tropics, especially S. America.

1. HIPTAGE, Gaertn.

Species 22.—From Mauritius to China.
Cooke has *H. Madablota*, Gaertn, which has to be changed into :

1. **Hiptage benghalensis**, (Linn.) Kurz in Journ. As. Soc. Beng., xiv, 2 (1879), 36; Niedenzu in Engl. Pflanzenr. iv, 141 (1928), 77.—*Banisteria benghalensis* Linn. Sp. Pl. (1753), 427, n. 4.—*Banisteria tetraptera*, Sonnerat Voy. Ind. Or. ii, (1782) t. 135.—*Hiptage Madablota*, Gaertn. Fruct. ii (1791), 169, t. 116; Wight II, (1838) t. 50.—*Gaertnera racemosa*, Roxb. Pl. Corom. i, (1795) t. 18.

Locality : Add : *W. Ghats :* Lonavla (Meebold); Khandala (Blatter !); Panchgani (Blatter !).

Distribution : Bombay Pres. : Konkan, W. Ghats, N. Kanara; Madras Pres. : N. Circars and Carnatic chiefly in ravines up to 6,000 ft., Ceylon, Mt. Abu (not in Sind as has Talbot); Siwalik, Kumaon, Nepal, E. Bengal, Assam, Burma, Andamans, Malay Peninsula, Siam, China, Malay Archipelago to Formosa and the Philippines.

2. ASPIDOPTERYS, A. Juss. (Cke. i, 158).

Species 17.—Tropical Asia.

Cooke has 3 species. I omit *A. Roxburghiana*, A. Juss. This species has been split up into 3 by Hutchinson (Kew Bull. (1917), 91): *A. indica*, (Roxb), Hochreut., *A. glabriuscula*, A. Juss. and *A. oxyphylla*, A. Juss. There is some likelihood that *A. indica* may occur in the Bombay Presidency. But so far there is no evidence, and Hutchinson is of opinion that *A. indica* is confined to the W. Peninsula and 'probably entirely to Madras.'

1. **Aspidopterys cordata** (Heyne) A. Juss. in Ann. Sc. Nat. ser. 2, xiii, (1840), 267.—*Hiræa cordata*, Heyne in Wall. Cat. (1828), 1060; Pl. As. Rar. i (1830), 13; Cke. i, 158.

Description : Cke. i, 158. 'In this species the pedicels above the articulation are always more or less hairy, but they are frequently glabrous towards the apex.' Hutchinson.

Locality : Add : *Konkan :* Thana district, Salsette (Jacquemont 991). Hills near Bhivandi (McCann !).

Distribution : Bombay Pres.: Konkan, Deccan, N. Kanara ; Mardas Pres.: Deccan, Bellary, Mysore.

2. **Aspidopterys canarensis**, Dalz. in Hook Kew Journ. Bot. iii. (1851), 37; Cke. i, 159.—*A. glomerata*, Wight Ic. (1853) t. 1986.

Description : Cke. l.c.

Locality : Add : *Konkan :* Near Bombay (Dalzell).

Distribution : The Bombay Ghats of the Konkan and Kanara ; Mysore, W. Ghats of Malabar to Tinnevelly.

ZYGOPHYLLACEÆ (Cke. i, 159).

Genera 22. Species 160.—Xero—and halophytes of tropical and subtropical regions.

1. TRIBULUS, Tourn. ex Linn. (Cke. i, 160).

Species 12.—Africa, Asia, America, Mediterranean.

1. **Tribulus terrestris,** Linn. Sp. Pl. (1753), 387 ; Cke. i, 160.

Description : Cke. l. c.

Locality : Add : *Sind :* Laki in Larkana (Sabnis B116 !) ; Khairpur (Sabnis B346 !) ; Mirpurkhas (Sabnis B847 ! B1035 !).—*Cutch* (Blatter !). —*W. Khandesh* (Blatter & McCann !).

Distribution : Warmer regions of the world.

2. **Tribulus alatus,** Del. Fl. Aegypt. iii, (1812), 62 ; Cke. i, 161.

Description : Cke l c.

Locality : Add : *Sind :* Thar and Parkar (Sabnis B627 !).—*Cutch* (Blatter !).

Description : Sind, Cutch, Rajputana Desert, Baluchistan, Persian Baluchistan, Arabia, Syria, Egypt.

2. SEETZENIA, R. Br. (Cke. i, 161).

Species 1.—Africa, Asia.

1. **Setzenia orientalis**, Dcne. Fl. Sin. in Ann. Sc. Nat. ser. 2, iii (1835), 281 ; Cke. i, 161.

Description : Cke. l c.

Distribution : Cutch, Rajputana Desert, Sind, Baluchistan, Arabia, N. & S. Africa.

3. PEGANUM, Linn.

Species 4.—Mediterranean, Asia, N. America.

1. **Peganum Harmala**, Linn. Sp. Pl. (1753), 444 ; Cke. i, 162.

Locality : Add : *Sind :* Hyderabad (Sabnis B238 !) ; Mirpurkhas (Sabnis B709 !).—*Cutch* (Blatter !).—*Konkan :* Bombay (Blatter !).

Distribution : Bihar, U. Provinces, Deccan, Konkan, Cutch, Sind, Baluchistan, Waziristan, Persian Baluchistan, Persia, Mediterranean, Central Asia.

4. ZYGOPHYLLUM, Linn. (Cke. i, 162).

Species 60.—Tropics of the Old World, desert and steppes.

1. **Zygophyllum simplex**, Linn. Mant. i, (1767), 68 ; Cke. i, 163.
Locality : Add : *Sind :* Manora (Sabnis B842 !) ; Mugger Peer (Sabnis B208 ! ; Hyderabad. Ganja Hill (Sabnis B998 !) ; Thar & Parkar (Sabnis B1098 !).—*Cutch* (Blatter !).
Distribution : Rajputana Desert, Cutch, Sind, Baluchistan, Arabia, Palestine, Egypt, Mediterranean, Somaliland, Cape Verde Islands. S. and S. W. Africa.

2. **Zygophyllum coccineum**, Linn. Sp. Pl. (1753), 386 ; Cke. i, 163.
Locality : Add : *Sind :* Sehwan (Sabnis B676 !) ; Laki (Sabnis (B82 !) ; Hyderbad (Sabnis B240 !) ; Ganja Hill (Sabnis B995 !) ; Mirpurkhas (Sabnis B882 !).
Distribution : Sind, Baluchistan, Arabia, Palestine, Egypt, Canaries, Nubia, Somaliland.

5. FAGONIA, Tourn. ex Linn. (Cke. i, 163).

Species 20.—Mediterranean to India, S. Africa, California, Chili.

1. **Fagonia cretica**, Linn. Sp. Pl. (1753), 386 ; Cke. i, 164.—*F. arabica*, Linn. l.c.—*F. Bruguieri*, DC. Prodr. i, (1824), 704.—*F. echinella*, Boiss. Diagn ser. i, viii, 123.—*F. diversifolia*, Boiss. Diagn. ser. ii, i, 112.—*F. Mysorensis*, Roth Nov. Sp. 215.—*F. cretica* var. *arabica*, T. Anders. in Journ. Linn. Soc. v, Suppl. i, 12.
Locality : Add : *Sind :* Karachi (Sabnis B782 !) ; Clifton (Sabnis B793 !, B804 !) ; Mugger Peer (Sabnis B210 !) ; Laki (Sabnis B121 !) ; Hyderabad Sabnis B992 !) ; Thar and Parkar (Sabnis 1061 !) ; Mirpurkhas (Sabnis B867 !); Jamesabad (Sabnis B970 ! ; B1115 !) ; Umerkot (Sabnis B1014 !).—*Cutch* (Blatter !).—*W. Khandesh* (Blatter and Hallberg !).
Distribution : Deccan, W. Khandesh, Cutch, Sind, Baluchistan, Waziristan, W. Rajputana, Upper Gangetic Plain, Punjab, westward to Afghanistan, Persia, Arabia and Mediterranean.

*6. GUAIACUM, Plum. ex Linn.

Species 1.—Warm America, W. Indies.
One species cultivated in India.

*1. **Guaiacum officinale**, Linn. Sp. Pl. (1753), 381.
Vern. Names : Guaiacum, Lignum Vitæ tree.
Description : A middle-sized or low ornamental tree, 9–12 m. high. Stem generally crooked, branches knotty, bark furrowed. Leaves evergreen, abruptly pinnate, with 2 or 3 pairs of ovate or obovate, obtuse, and perfectly smooth leaflets, 6–12 mm. long. Flowers in small clusters. Calyx 5-partite, sepals oval, hairy, thrice exceeded by the blue petals. Stamens 10. Style tapering. Fruit a capsule, roundish, compressed, 5-angled, 5-celled, or the cells by abortion fewer, one seed in each cell.
Distribution : Inhabits some of the W. India Islands and the Florida Keys. —Planted in India.

7. BALANITES, Del. (Cke. i, 195, under *Simarubaceæ*).

Species 3.—Egypt, tropical Africa and India.
Cooke has 1 species : *Balanites Roxburghii*, Planch. I unite this with *Balanites acgyptiaca*, Delile, as the differences between the 2 species are too insignificant for a specific separation.
1. *Balanites ægyptiaca*, Del. Ill. Fl. d'Eg. (1813), 263, t. 28, f. 1.—*Ximenia ægyptiaca*, Linn. Sp. Pl. (1753), 1194.—*X. ægyptiaca*, Juss. Gen. 260 — *X. Agihalid*, Mill. Gard. Dict. ed. viii, no. 2.—*X. ferox*, Poir. Encycl. viii, 805.—*Balanites Roxburghii*, Planch. in Ann. Sc. Nat. ser. 4, ii (1854), 258 — *B. ægyptica*, Wall. Cat. no. 6855 ; Wight Ic. t. 274.—*B. ferox*, G. Don Gen. Syst. i, 774.—*Agialida Roxburghii*, O. Ktze.

Description : A shrub or small evergreen tree, rarely reaching 9 m. Young parts pubescent or tomentose or glabrescent. Twigs armed with stout axillary or supra-axillary spines, 1–6 cm. long, which often bear leaves or flowers. Leaves alternate, 2-foliolate ; petioles 3-6 mm. long ; leaflets elliptic or rotundate, obtuse or subacute or broadly pointed, 1–5 cm. long ; petiolules up to 5 mm. long. Flowers small, greenish white, fragrant, in axillary few– or many-flowered short-peduncled cymes or fascicles. Sepals 5, ovate, 3 mm. long, pubescent outside, silky within. Petals 5, oblong-obovate, glabrous outside, silky-villous or glabrous inside, very little longer than the sepals. Stamens 10 ; filaments subulate, glabrous ; anthers dorsifixed. Disk cupular, with a 10-lobed glandular margin. Ovary ovoid, silky, 5-celled ; ovules solitary in each cell ; style short, conical. Fruit an ovoid drupe, 2·5–6 cm. long, on a short thick stalk, faintly 5-grooved, pale yellow when ripe ; pulp 5 mm. thick, with an offensive greasy smell ; stone hard, fibrous. Seed exalbuminous ; embryo with thick plano-convex, corrugated or 2-lobed cotyledons and a superior radicle.

Distribution : Drier parts of India, Arabia, Egypt, Eritrea, tropical Africa.

GERANIACEÆ

Annual herbs or undershrubs, rarely arborescent ; leaves alternate or opposite, mostly lobate, dissected or compound ; stipules often paired ; flowers often handsome, hermaphrodite, actinomorphic or slightly zygomorphic, axillary, solitary to subumbellate ; sepals persistent, 4–5, free or connate to the middle, imbricate or rarely valvate, the dorsal one sometimes spurred ; petals 5, rarely 4, very rarely absent, hypogynous or subperigynous, imbricate, rarely contorted ; stamens 2–3 times the number of the sepals, sometimes a few without anthers, filaments mostly more or less connate at the base ; anthers 2-celled, opening lengthwise ; ovary 3-5-lobed ; ovules 1–2 in each cell, superposed, pendulous, rarely more than 2 ; fruit lobed, lobes 1-seeded, rarely more-seeded, often beaked ; seeds pendulous, with thin or no (rarely copious) endosperm and mostly curved embryo.

Genera 11. Species 650.—Cosmopolitan.

1. MONSONIA, Linn.

Species 30.—Africa, Asia.

1. **Monsonia senegalensis,** Guill. et Perr. Fl. Seneg. Tent. i, (1830), 131.—*M. asiatica*, Vicary in Journ. As. Soc. Beng. xvi, (1847), 1161.—*M. Lawiana*, Stocks ex Wight in Calc. Journ. Nat. Hist. vii (1847), 19.—*M. chumbalensis*, Wight Ic. iii, 5, t. 1047.—*Erodium chumbulense*, Munro ex Wight Ic. iii, t. 1074.—*Geranium Lawianum*, Nimmo in Grah. Cat. Pl. Bomb. Add. *post ind.*

Distribution : Deccan Gujarat, Cutch, Sind, W. Rajputana, U. Provinces, Baluchistan, Arabia, Senegambia, Abyssinia, Kordofan, German, E. Africa, Hereroland.

2. **Monsonia heliotropioides,** (Cav.) Boiss. Fl. Or. I (1867), 897.—*M. hispida*, Boiss. Diagn. ser. 1, viii, (1849), 120,—*M. mallica*, Edgew. in Journ. Linn. Soc. vi (1862), 200.—*Geranium heliotropioides*, Cav. Diss. iv, (1787), 220, t. 113, f. 2.—*Erodium heliotropioides*, Willd. Sp. Pl. iii. (1800), 638.

Distribution : Sind, Multan, Rajputana Desert, S. Persia, Arabia, Egypt, Nubia.

* 2. PELARGONIUM, L'Hérit

Species 250.—Chiefly S. African, a few Mediterranean, Australian ; not indigenous in India.

A number of Pelargoniums, usually called Geraniums are cultivated in Bombay gardens. The commonest are :

*1. **Pelargonium peltatum,** (Linn.) Ait. Hort. Kew ii, (1789), 427.—*Geranium peltatum*, Linn. ; Curtis Bot. Mag. i (1793) t. 20.

The Ivy-leaved Geranium.

A weak and straggling plant. Leaves thick and shiny, slightly peltate and prominently angle-lobed. Flowers 2-lipped, pink or reddish.

Native Country : S. Africa.—This is the parent of the Ivy-leaved Geraniums.

* 2. **Pelargonium lateripes,** L'Hérit. Geran. (1787–88) t. 24.
Ivy-leaved Geranium.
Has a graceful drooping growth. Leaves cordate, not peltate.
Native Country : S. Africa.

* 3. **Pelargonium inquinans,** (Linn.) Ait. Hort. Kew. ii, (1789), 424.
Fish Geranium.
Plants very velvety and sometimes viscid. The leaves not zoned, long-petioled. orbicular-reniform, crenate. Calyx-tube densely glandular and viscid. Petals broadly obovate, scarlet, but also varying to lighter colours.
Said to be the parent of most of the 'scarlet geraniums' of English gardens.
Native Country : S. Africa.

* 4. **Pelargonium zonale,** (Linn.) Ait. Hort. Kew. ii, (1789), 224. Zonal or Horseshoe Geranium.
Shrubby, with a strong fishy odour ; young branches succulent, somewhat hispid. Leaves round-cordate, usually with a zone or horseshoe-mark of deeper colour on the upper surface. Petals narrow wedge-shaped or spathulate. Flowers scarlet and crimson through all shades of red to pure white.
Native Country : S. Africa.

* 5. **Pelargonium quercifolium,** (Linn. f.) Ait. Hort. Kew ii, (1789), 422 ; L'Hérit. Geran. (1787–88) t. 14.
Oak-leaved Geranium, Scarlet-flowering Rose Geranium.
Shrubby and branchy, somewhat hairy and glandular. Leaves with stalks 5–10 cm. long, cordate-ovate, with 2-3 pairs of oblong side lobes. Flowers few to several, rather small, in umbels, red or purplish.
The leaves have often a dark spot and are not agreeably scented.
Native Country : S. Africa.

* 6. **Pelargomium radula,** (Cav.) L'Hérit. Geran. (1787–88) t. 16. Rose Geranium.
Leaves deeply palmately parted, the lobes narrow linear and pinnatified, margins revolute, rough hispid on the upper surface, soft-pubescent beneath. Flowers small, pale purple, with dark streaks. Sepals setose and glandular.
Native Country : S. Africa.

3. Ērodium, L'Hérit. (Cke. i, 166)

Species 65.—Chiefly temperate.

1. **Erodium cicutarium,** L'Hérit. ex Ait. Hort. Kew. ii, (1789), 414 ; Cke. i, 166.
Distribution : Sind, Baluchistan, Jaisalmer, Punjab, W. Himalaya.—Cosmopolitan.

OXALIDACEAE

Herbaceous or suffrutescent, rarely arboresscent; leaves alternate, digitately or pinnately compound, sometimes simple by suppression of the leaflets ; leaflets spirally coiled when young, usually closing at night ; stipules absent ; flowers hermaphrodite, actinomorphic, sometimes of two kinds, some perfect and others minute and apetalous ; flowers solitary or subumbellate, rarely racemose or cymose ; calyx 5-fid or partite, imbricate ; petals 5, shortly clawed, free or shortly connate at the base, contorted ; stamens 10, hypogynous, connate at the base, sometimes five without anthers ; anthers 2-celled, opening lengthwise ; ovary 5-celled, superior ; styles 5, free, persistent ; stigmas capitate or shortly divided ; ovules 1 or more, axile ; fruit mostly a capsule ; seeds often with an elastic testa ; endosperm fleshy, copious ; embryo straight.
Genera 7. Species about 880.—Mostly tropical and subtropical.

1. Oxalis, Linn. (Cke. i, 167).

Species 791.—Cosmopolitan, chiefly S. Africa and America.
Cooke has 1 species. I add a new variety of the same, and 2 species which have become naturalized.

I. Flowers yellow ... ... 1. *O. corniculata*

II. Flowers violet
  1. Leaflets 3 ... ... 2. *O. latifolia.*
  2. Leaflets 4 ... ... 3. *O. tetraphylla.*

1. **Oxalis corniculata,** Linn. Sp. Pl. (1753), 435. For synonymy see R. Knuth in Engler's Pflanzenr. iv, 130 (1930), 146.

Var. corniculata, Zucc. in Abh. Akad. Muench. i, (1825–30), 230.
Stems prostrate or creeping, like the whole plant more or less pilose Peduncles sub 5-flowered. Capsules pubescent.
Locality : All over the Presidency.
Distribution : Cosmopolitan.

Var. hispida Blatter. *var. nov.*
Flores pallide lutei. Sepala intus glabra, extus adpresse hirsuta. Fructus pilis patentibus hispidus.
Locality : W. Ghats : Panchgani (J. Fernandez !).

2. **Oxalis latifolia,** H. B. K. Nov. Gen. et Sp. v, (1821), 184, t. 467.
Description : When in flower 17–23 cm. high, stemless. Roots arising from the lower surface of a round bulb, fibrous, brown, very much branching; scales of bulb deep brown, many-nerved. Basal leaves 3–8, 3-foliolate, petiolate ; leaflets below paler, often 37 mm. broad, 21 mm. long, apex with a broad not very deep sinus ; lobes divergent, more or less oval, with a few hairs or with scattered cilia on the margin ; petioles about 8–14 cm. long. Peduncles basal, pilose or glabrous, up to 1½ times as long as the leaves, 14–23 cm. long, bearing a simple 6–13-flowered umbel. Bracts broad at the base, more or less abruptly acuminate, acute, 1–3 mm. long, glabrous. Pedicels 1–2 cm. long, slender, glabrous or subglabrous. Sepals oblong or lanceolate-oblong, 3·5–5 mm. long, acute, glabrous, at the apex with 2 red callosities. Petals violet, 8–13 mm. long, Longer stamens pubescent, appendiculate on the back ; the shorter ones glabrous.
Locality : Naturalized at Panchgani.—Has also been found in the Pulney Hills, Simla, Kumaon, Mussoorie, Shillong, Sibpur. Native of Mexico.

3. **Oxalis tetraphylla,** Cav. Ic. iii, (1794), 19, t, 237 ; Link & Otto Abbild. ii, 21, t, 11,
Description : In flower 30 cm, high and more, stemless, Roots arising from the lower surface of the bulb, tortuose, black, rather thin, Bulb 15–35 mm. diam., more or less spherical, covered with scales ; scales 25 mm. long, lanceolate, acuminate, acute, nerved. Leaves basal, few, 3–6 ; leaflets 4, rotund-obtriangular, with the margin at apex retuse, scarcely excised, membranous, glabrous or provided especially below towards the nerves with long hairs, on both surfaces minutely impressed-cellular, up to 35 mm. long and broad. Petioles fleshy, glabrous, 5 times as long as the leaflets or longer, 12–30 cm. long, Peduncles basal, glabrous or provided with scattered long hyaline cilia, 20–35 cm. long, bearing a simple, 5-12-flowered umbel. Bracts lanceolate, slightly acute, reddish at apex, 2–5 mm. long, Pedicels 1·5–2 cm. long, thin, glabrous. Sepals lanceolate, obtuse, at the apex red-callose, 5 mm. long. Petals 4–5 times as long as the sepals, reaching 20 mm. narrowly cuneate at the base, spathulate-obovate, at the apex retuse-rotundate, violet. Stamens and styles puberulous.
Locality : W. Ghats : Panchgani (Blatter !), naturalized.
Also found at Ootacamund, Pulney Hills, Simla, Shillong.—Native of Mexico.

2. BIOPHYTUM, DC. (Cke. i, 167).

Species 51.—Tropics.
Cooke has one species. I add *B. Reinwardtii.*
1. Pedicels 3–10-flowered. Leaflets 2–3 times as long-as broad ... ... 1. *B. sensitivum.*
2. Pedicels 3–6–flowered. Leaflets 4–5 times as long as broad ... ... 2. *B. Reinwardtii*

1. **Biophytum sensitivum**, (Linn.) DC. Prodr. i, (1824) 690; Cke. i, 167.—*Oxalis sensitiva*, Linn. Sp. Pl. (1753), 434; Roxb. Fl. Ind. ii, (1832), 457; Wight and Arn. Prodr. i, (1834), 142.—*Toddavaddia sensitiva*, O. Ktze. Rev. Gen. i, (1891) 96.—*Herba sensitiva*, Rumph. Herb. Amb. v, (1747), 301, t. 104.

Locality: Add: *Khandesh* (Blatter!).

Distribution: Throughout the hotter parts of India. Very likely distributed all over tropical Africa and Asia to the Philippines.

2. **Biophytum Reinwardtii**, (Zucc.) Klotzsch. in Peters Reise Moss. Bot. (1862), 85.—*B. sensitivum* var. *Reinwardtii*, (Zucc.) Guillaum. in Bull. Mus. d'Hist. Nat. xv, (1909), 127.—*Oxalis sensitiva*, Zucc. in Denkschr. Akad. Muench. ix, (1823–24), 183.—*O. gracilenta*, Kurz in Journ. As. Soc. Beng. xxxix, 2 (1870), 68.—*Todda Vaddi*, Rheede Hort. Mal. ix, (1689), 33 t. 19.

Description: In flower 6–12 cm. high. Stem up to 8 cm. high, sometimes very short, simple, with short scattered appressed hairs; crowned at the apex with 6–17 leaves. Leaves up to 5-7 cm. by 13–18 mm., 14-20-jugate; petiole thin, filiform, puberulous, interspersed with remote, setaceous hairs; largest leaflets up to 8-9 mm. long and 2·75–3 mm. broad, elongate-triangular, retuse at the base (the apical ones cuneate-spathulate or almost triquetrous) glabrous or slightly setaceous-pilose, the same colour on both sides. Peduncles more or less as long as the leaves, 2–7 cm. long, densely puberulous like the pedicels, slender, 3–7-flowered. Bracts minute, linear-subulate or subulate, very acute, scarcely 1 mm. long, scarcely coacervate. Pedicels often 5 mm. long, filiform. Sepals more or less pubescent or glabrescent, lanceolate, acute, more or less strongly 5-nerved, 2·5 mm. long. Petals cuneate, about thrice as long as the calyx, up to 8 mm. long. Seeds very cristate-favoso-tuberculate.

Locality: Bombay (Boivin 351 ex R. Knuth).

Distribution: W. Coast and W. Ghats from S. Kanara to Cochin and Anamalai Hills up to 6,000 ft., Upper Gangetic Plain, Dehra Dun, Garhwal, Ceylon, Malay Peninsula, China, Malaya to the Philippines.

3. AVERRHOA, Linn. (Cke. i, 168).

Species 2.—Cultivated in all tropical countries.

1. **A. carambola**, Linn. Sp. Pl. (1753), 428; Cke. i, 168.—*Tamara Tonga*, Rheede Hort. Mal. iii (1682), t. 43.—*Prunum stellatum*, Blimbing Rumph. Herb. Amb. i, (1750) t. 53.

Distribution: Cultivated throughout the tropics.—Perhaps a native of Malaya.

2. **A. bilimbi**, Linn. Sp. Pl. (1753), 428; Roxb. Fl. Ind. ii, (1832), 451. Cke. i, 168.—*Bilimbi* Rheede Hort. Mal. iii, (1682), 3, t. 45.—*Blimbing bula*, Rumph. Herb. Amb. i, (1750) t. 36.

Distribution: Cultivated throughout the tropics. Very likely a native of Malaya.

* TROPÆOLACEÆ (not in Cke.)

Succulent prostrate or twining herbs with watery juice; root often tuberous; leaves alternate or the lower opposite, simple, peltate, sometimes dotted; stipules absent; flowers hermaphrodite, zygomorphic; solitary, axillary; calyx coloured, 2-lipped; sepals imbricate or valvate, the lateral often broader, the dorsal produced into a spur (sometimes regarded as a part of the axis); petals 5 or rarely fewer by abortion, slightly perigynous, imbricate, the upper two exterior and often more or less different from the others; stamens 8, free, declinate; anthers 2-celled, opening lengthwise laterally; ovary superior sessile, 3-celled, cells 1-ovulate; ovule pendulous; style one, apical, with 3 stigmas; carpels separating from the short central axis, indehiscent, hardening, rugose; seeds without endosperm; embryo straight with thick fleshy cotyledons.

Genus 1. Species 50.—S. America, Mexico. Only cultivated species in the Presidency.

*1. **Tropæolum majus**, Linn. Sp. Pl. (1753), 345; Bot. Mag. i, (1787), t. 23. Nasturtium, Indian Cress.

Description : A strong-growing somewhat succulent climbing annual. Leaves peltate, nearly orbicular and undulate-angled. Flowers large, mostly in shades of yellow or orange. Spur straight ; the 2 upper petals entire or undulate, the 3 lower narrower and fringed on the claws.

The number of varieties is very great. There are flowers of pale straw colour, orange, scarlet, dark rich crimson brown, and of every intermediate hue, spotted and striped.

Native Country : Peru to New Granada.

* 2. **Tropæolum minus,** Linn. Sp. Pl. (1753), 345 ; Bot. Mag. (1792) t. 98.

Nasturtium.

A dwarf annual, not climbing, smaller in all its parts than *T. majus.* Leaves orbicular-reniform, apiculate at the ends of the veins. Petals narrow, apiculate at the apex, the lower intensely spotted.

Native Country : Peru.

* 3. **Tropæolum peregrinum,** Linn. Sp. Pl. (1753), 345.—*T. aduncum,* Sm. A Sketch, etc. i, (1793), 158 ; Bot. Mag. xxxiii, (1811) t. 1351.

Canary Bird Flower.

A tall-climbing annual. Leaves peltate near the margin, cordate-orbicular, 5-lobed to about the middle. Flowers canary-yellow, odd and very irregular ; spur green, hooked ; 2 upper petals erect and large, obovate-clawed, 3 lower small, narrow, ciliate.

Native of Peru, and perhaps also of Ecuador.

(*To be continued.*)

THE BIRDS OF THE PROME DISTRICT OF LOWER BURMA.

BY

J. K. STANFORD, M.C., I.C.S.

WITH NOTES ON THE COLLECTION.

BY

DR. CLAUD B. TICEHURST, M.D., M.A., M.B.O.U., F.R.G.S.

PART II

(*Continued from page 672 of this volume.*)

White-Throated Bulbul (Criniger tephrogenys burmanicus). 345, 385.

Oates (B. B. I. 183) describes *C. griseiceps* as 'generally diffused over the hills of Pegu extending down to the towns of Rangoon and Pegu. On the western side . . . . . . it is probably altogether absent.' In the *Fauna*, ed. i. (i. 256) the distribution of *C. burmanicus* is given as from 'Toungoo, Karen hills, etc'; in the *Fauna*, ed. ii. (i. 364) from 'hills E. of the Salwin from Yamethin to Moulmein', which is a geographical impossibility. The distribution of both forms needs further investigation.

I shot one at about 2,500 ft. on the Nyaunggyo stream on 3rd April, 1929, and another not far from the same place on 9th April, 1929. I did not see it elsewhere.

[These two birds (♂, W. 100, ♀ 99·5) are certainly not *griseiceps*, which the *Fauna* gives as inhabiting central West Burma south to Tenasserim. They are nearest *burmanicus* from Toungoo but are a little less brown on the upper parts; more specimens from Arakan are needed. *Griseiceps* was described from Upper Pegu.]

Black Bulbul (Microscelis psaroides nigrescens). 379.

Blyth recorded a specimen from Arakan. Oates did not meet it. I found this species common between 2,500 ft. and 3,000 ft. but only collected one, a male, on 9th April, 1929. It was nearly always seen in pairs and the long-drawn cat-like note was most noticeable.

Himalayan Brown-eared Bulbul (Hemixus f. flavala). 330, 356.

Oates' collectors got it in 'the hills of Arakan,' probably near Nyaunggyo. I shot two at the same place on 2nd and 4th April, 1929. Those I saw were in pairs in evergreen forest at 2,500 ft.

[I can match this with examples from Sikkim.]

Rufous-bellied Bulbul (Hemixus macclellandi sub-sp. ?). 329.

Blanford and Oates recorded it from Arakan.

I shot a single ♂ out of the top of a very high tree in dense evergreen forest on the Nyaunggyo stream at about 2,400 ft. on 2nd April, 1929. This was the only one seen for certain.

[This single specimen (a ♂, wing 113) does not correspond with the typical race from Assam on the one hand, nor with *tickelli* from Tenasserin on the other. It may well be that there is a distinct race in the Arakan Yomas but further specimens must be obtained.]

Burmese Red-vented Bulbul (Molpastes hæmorrhous burmanicus). 159.

The common bulbul of the plains in Prome district. It is said by Blyth to occur in Arakan, but it was conspicuous by its absence above 1,000 ft. on the Taungup road in April 1928–29. Very great numbers roost together in canebrake jungle near Prome.

Burmese Red-whiskered Bulbul (Otocompsa jocosa erythrotis). 229.

Oates remarks that it abounds 'in the whole of Pegu except the portion lying between Prome and Thayetmyo, where it is very rare or absent altogether.' I should say without hesitation that it was confined to the southern half of the district, along the Irrawaddy valley, and by no means common. I saw a pair on the Letpanbu *jheel*, the most northerly point at which I saw any. None was seen in the Arakan hills in either 1928 or 1929. It is a bird which frequents not gardens or villages but dry scrub jungle near the river, and is very local.

[This is *O. emeria peguensis* of the *Fauna*.]

Black-crested Yellow Bulbul (Otocompsa flaviventris). 387.

Oates describes it as common through Pegu and 'not easily overlooked.' I found it exceedingly common and conspicuous (in fact it was the most common Bulbul) in the Arakan hills in 1928 and 1929 where it was breeding in April, but nowhere else. Subsequently I found it common lower down the Pegu Yomas in the Insein district, so that I do not think I overlooked it over the greater part of Prome district. A nest with one egg found in a mango tree at Nyaunggyo in mid-April 1928, the bird of which I could not identify, was almost certainly that of this bird (Stuart Baker *in litt.*). On 9th November, 1929, it may be worth recording that a very large gathering of these birds appeared in my garden at Insein and moved on an hour later. These were, I think, undoubtedly migrants.

[This single bird is more olive, less golden above, and paler, and less rich yellow below than the typical race; a ♀, wing 83·5. A further series is desirable.]

Olive Bulbul (Iole olivacea virescens).

Oates describes it as plentiful in Pegu 'except in the dry portion near Thayetmyo and Prome where it appears to be absent.' I saw none but may have confused it with *Pycnonctus blanfordi*.

Blanford's Olive Bulbul (Pycnonotus blanfordi). 46, 167, 191.

Very common all over the plains; not seen in the hills.

Black-headed Bulbul (Microtarsus m. melanocephalus).

According to Oates it is found only in the southern portion of Pegu. I never saw it at Prome.

Slaty-bellied Wren (Tesia cyaniventer cyaniventer). 328.

Oates does not record it south of Manipur. I obtained a female on 2nd April, 1929, at Nyaunggyo (2,400 ft.) and was quite unaware, till later, of its identity or could have collected others. This bird was feeding in bushes on a bank in evergreen jungle and uttering a single note, twice or thrice repeated. On 9th April, near the same place, I watched one hopping about and singing on the ground in dense undergrowth, a very powerful and sweet song of seven or eight notes, and so ventriloquial that it took me ten or fifteen minutes to locate it, though it was within a few yards of me.

[In this female the head is coloured as the back; I cannot distinguish it from Sikkim examples.]

Burmese Stone-Chat (Saxicola caprata burmanica). 138.

Very common all over the plains and foot-hills. I did not see it above 500 ft. Breeds in pea-fields in the Irrawaddy valley in February and March. Appears to be a resident, but in January 1929, I noticed nothing but males. I have noticed this with the British Stone-Chat and it is possible that the sexes winter apart.

Japanese Bush-Chat (Saxicola torquata stejnegeri). 42.

Oates describes it as a very common winter visitor. I saw considerable numbers, but it was mainly confined to the Irrawaddy valley, in the drier sandy land.

[Paler on the breast than most *indica*; *stejnegeri* usually but not quite always has a broader and stouter bill than *indica*.]

White-tailed Bush-Chat (Saxicola torquata leucura). 50. 57.

Oates describes it as 'somewhat rare' and only got it a few miles south of Thayetmyo, but quotes Blanford as saying that it is a constant resident along the Irrawaddy. I saw many obviously paired and apparently breeding in long grass on the Irrawaddy islands in February and March. The female much resembles a Spotted Flycatcher and not a Chat at all

Western Dark-grey Bush-Chat (Oreicola ferrea ferrea). 213, 419.

Oates (i. 283) states that he got *O. ferrea* once near Prome. This record is not apparently accepted by Stuart Baker (ii. 38), or was subsequently corrected. Henricks shot a ♂ at Ngaphaw in the foot-hills of the Pegu Yomas on 25th February, 1929 (200 ft.), and another at Sinde on 15th March, on the west bank of the Irrawaddy, both in low hills covered with scrub.

[These two birds are quite indistinguishable from N. W. Himalayan birds.]

Jerdon's Bush-Chat (Oreicola jerdoni).

Oates saw it in March at Letpadan (B and O. 11. 66.) in the Tharrawaddy district considerably south of Prome district. This is very probably why Stuart Baker records it as extending 'as far as Prome.'

Spotted Forktail (Enicurus maculatus guttatus).

Oates (i. 26) records it from Manipur and Arakan and says he got it at Nyaunggyo, and 'had no doubt it was common.'

I saw two or three pairs in company with the next species near Nyaunggyo and obviously breeding, but failed to obtain one.

Black-backed Forktail (Enicurus immaculatus) 369, 407.

Oates (i. 25) found it on both sides of the Pegu Yomas and very common in all the mountain streams. The only two forktails which I obtained at Nyaunggyo were males of this species, but I am satisfied that *guttatus* also inhabited exactly the same streams. I saw a single forktail at a tiny pool of foul water at about 1, 500 ft. on the eastern slopes of the hills, in burnt jungle, this pool being probably the only water of any kind for many miles. It undoubtedly breeds in the Arakan hills, but I was unable to find a nest.

Chinese Red-spotted Bluethroat (Cyanosylvia suecica robusta). 45, 35.

Oates (i.15) found it common in Pegu from November to May, in tracts covered with dense elephant grass. Large numbers frequented the swampy reed-beds of a small stream on the Nawin marshes in January 1929. They were exceedingly shy and skulking, but, if watched quietly from a distance, would come out and hop about on the marsh like Redbreasts. Not seen after March, and most of them had probably disappeared by that time.

[Three males wing. 75·5–77·5; bill 17–17·5. Tips of primaries exceed secondaries by 15–20 mm. Large birds, very dark and grey on upper parts. These match well birds from various parts of China.]

White-tailed Blue Robin (Notodela leucura). 401.

Up to 1890 it had not been recorded south of Manipur, except in Karennee and Tenasserim. I shot a single male at Nyaunggyo on 12th April, 1929, which flew silently out of bamboo jungle on to a path. This bird is probably not rare but overlooked in the country it frequents.

Indian Magpie-Robin (Copsychus saularis saularis). 160, 286.

Very common and resident. I have seen it hawking flying ants with Drongos. Not seen in the Arakan hills in April 1928 or 1929.

Shama (Kittacincla malabarica malabarica). 79, 360.

Found up to 2,500 ft. in the Arakan hills in dense bamboo jungle where, judging by its song in the evenings, it is extremely numerous but rarely seen. The only two nests I have seen were both in artificial holes in large bamboo posts. One held incubated eggs on 5th April and the other, made largely of horsehair, was built in May in a post of my stable, despite almost hourly disturbance by syces. This bird deserted after sitting some days.

[This is *K. macroura indica* of the *Fauna*. Kloss has pointed out that the oldest name for this bird is *malabarica* of Scopoli. 1786.]

Orange-headed Ground-Thrush (Geocichla c. citrina). 342.

Oates described it as found throughout the whole of Burma, and resident. He found it breeding in May and June, apparently in the plains. I saw several near Nyaunggyo between 2,500 ft. and 3,000 ft. in evergreen forest in April 1928 and 1929, apparently paired and breeding. One bird attracted me by its song from some distance off and was feeding on a '*Nyaung-bin*'. It is remarkably fearless of man, but if it sits motionless, is easy to overlook.

Mountain-Thrush (Oreocincla dauma dauma). ♀ 370.

Oates got it on the Pegu hills in April. Henricks shot a single female at Nyaunggyo on 6th April, 1929, in evergreen bamboo jungle.

Lesser Brown Thrush (Zoothera marginata).

Oates (i. 8) got one in the Arakan hills, 'where Mr. Blyth first got it I believe. I have not observed it in Pegu'.

I shot one of a pair on the Nyaunggyo stream in April 1928, but did not preserve it, nor did I see any in 1929.

[Specimens of this bird are very highly desirable as it was from Arakan that Blyth described the species.]

Burmese Blue Rock-Thrush (Monticola solitarius). 33, 211.

Oates (i. II) describes it as 'found abundantly over the whole of British Burma during the cold season', arriving in October and leaving in March. It is a very silent and unobtrusive bird and frequently seen on bungalow roofs at this time. I saw one at Nyaunggyo on 14th April, 1928, which was possibly on migration.

[These two females might be equally *pandoo* or *affinis*. W. 117, 118.]

Himalayan Whistling-Thrush (Myiophoneus t. temminckii).

Oates describes it as found 'on the Arakan hills and its spurs, nearly down to the Irrawaddy'. I saw several on the streams near Nyaunggyo in April 1928 and 1929 where they were undoubtedly breeding, and it possibly comes lower down in the rains. I failed however to find a nest, and on being disturbed, they would vanish at once into evergreen jungle, where they would sit motionless for long periods. I regret that I failed to obtain any, but have little doubt they were of this race.

Sooty Flycatcher (Hemichelidon sibirica gulmergi). 390, 395.

Oates describes it as a rare winter visitor over the whole of Burma. I saw several at 3,000 ft. along the road near the Taungup Pass on 10th April, 1929, and shot another in bamboo jungle on the 11th April. Those seen on the 10th appeared to be single males or pairs, and I thought they were probably breeding.

[The race of Sooty Flycatcher wintering in Burma is, according to Mr. Stuart Baker, *H. s. cacabata*. These two birds however I cannot in any way separate from N. W. Himalayan birds. The distribution given for *gulmergi* in the *Fauna* is N. W. Himalayas from Afghanistan to Gharwal, but this is only the summer distribution ; where it goes in winter is not stated.]

Red-breasted Flycatcher (Siphia parva albicilla). 22, 85, 175.

Oates observed it in Pegu from mid-November to the end of March and states that it was recorded from the Thoungyin valley in mid-September.

The earliest I have seen was on 17th September, 1928, but it is common by early October.

This bird is the most abundant of the flycatchers throughout the cold weather but is nearly always seen singly. Though a great number are probably scattered over one stretch of jungle, one rarely if ever sees two birds together. It leaves in late March or April.

[It is stated in the *Fauna* that the females and young (1st winter) birds are not distinguishable from those of *parva*. Most of them including these four birds are quite distinguishable by the colder, greyer, brown upper parts and the whiter under parts suffused with grey on the breast instead of creamy white suffused with buff.]

Blue-throated Flycatcher (Cyornis rubeculoides dialilæma). ♂, ♀, 164, 217, 376, 405.

According to Oates, very common in winter. I did not find it very common in Prome but shot a female at 300 ft. near Ngapaw on 26th February and others on 7th and 12th April, 1929, at Nyaunggyo, where I saw several which appeared to be in their breeding haunts.

[A pair from the plains and a pair marked as breeding from the Arakan hills seem to be the same. The males have an inverted V wedge of rufous running up into the blue of the throat. The females are quite as in *rubeculoides*. These correspond with *dialilæma* well. From Arakan, Messrs. Kinnear and Robinson (Novit. Zool. 34, p. 233) have described a race of *rubeculoides* as *rogersi*. A female of this race examined by me seems very distinct with markedly warm brown upper parts. The Nyaunggyo female obtained by Mr. Stanford and thought to be breeding does not correspond at all with the female of *rogersi*.]

Verditer Flycatcher (Stoparola m. melanops). ♂ ♀, 118, 168.

Henricks obtained a female at Tarokmaw on 4th February and a male near Prome on the Irrawaddy on 15th February. I did not observe it.

Grey-headed Flycatcher (Culicicapa c. ceylonensis). ♂ ♀ ♂, 201, 335, 374.

Oates remarks: 'In Upper Pegu apparently confined to the hills alone.' Henricks shot a ♂ near Prome on 15th February, and I saw a good many in the Arakan hills in open tree jungle in April, 1929. They appeared to be breeding and were very tame, flying all round an intruder at close quarters.

Northern Indian Black-naped Flycatcher (Hypothymis azurea styani). ♀♀, 19, 381.

Probably common and resident. One was obtained near Paukkaung on 18th January, and a single female at 2,400 ft. on 8th April at Nyaunggyo.

Burmese White-browed Fantail Flycatcher (Rhipidura aureola burmanicus). 319.

Oates described it as uncommon except in the northern part of Pegu near Thayetmyo.

I shot a male at Hmawza on 30th March, 1929, out of a flock in *indaing* jungle.

White-throated Fantail Flycatcher (Rhipidura a. albicollis).

Oates says it breeds in 'May, June and July'; Stuart Baker says, 'March to July'. I should say it was fairly common and resident. I saw a pair on the Nyaunggyo stream at 2,400 ft. with a fledged young one on 2nd April, 1929.

Burmese Shrike (Lanius colluroides). Local name *Hngetsat*. 1, 69, 127, 158.

Oates remarks on its abundance in the Prome District, where I found it common and widely distributed, in the cold weather. Oates says it is absent or very rare from the middle of March to the end of June. I certainly noticed its almost total disappearance by mid-March. Not seen in the Arakan hills in April, 1928 or 1929.

[These birds in January and February all show some moult on the underparts and appear to be completing a body moult. The wings and tails have not been recently moulted.]

Brown Shrike (Lanius c. cristatus). 70, 266.

Oates describes it as a common winter visitor. Henricks obtained a male on 24th January, 1929, at Kandin on the Rangoon road, and I obtained one near Prome on 11th March.

[The March bird is in very worn dress and moult not yet begun.]

Grey-backed Shrike (Lanius schach tephronotus). 357.

Oates did not meet it, but it was recorded from the Arakan hills by Blyth. The only Shrike seen by me in the Arakan hills in 1929 was a single ♀ of this species at Nyaunggyo on 4th April.

[This bird is just finishing a complete moult on 4th April.]

Indian Black-headed Shrike (Lanius n. nigriceps).

Oates observed it at Prome. I imagined I saw it but all the specimens collected were *colluroides*.

Black-backed Pied Shrike (Hemipus picatus). 148, 149.

Oates describes it as resident over the whole of Pegu but by no means common and not recorded from Arakan. I only saw it twice, a small flock in *indaing* jungle near the northern border of the district (both those obtained were males) on 11th February, 1929, and a pair at 3,000 ft. on the Arakan hills near the Taungup Pass on 10th April, 1929.

[These males are in immature dress of first winter and the race indeterminable.]

Nepal Wood-Shrike (Tephrodornis gularis pelvicus). 350, 355, 375.

Oates describes it as a constant resident over the whole of Pegu. I found it nowhere except between 2,400 ft. and 3,000 ft. in the Arakan hills where it was still in small parties in early April. Of one party, I noticed that individuals sat bolt upright and had the typical swearing note of a shrike and did not resemble *pondiceriana* in habits at all.

[One of these April specimens is a bird of the previous year and has the tail feathers much narrower than in adults; the outer tail feathers show the curious wavy markings which young shrikes show. The lores and ear coverts are brown instead of black. In all the grey of the head is confined to the crown thus showing a tendency to *pelvicus*, on the other hand, the size is rather small (wing. 114–120) for that race in which the wing measures 115–130 mm. thus showing also a tendency to the Siam race *annectens*. The largest from Nepal of course grades right through to the smallest, *gularis* (w. 87–94) from Java, a very good instance of diminution in size of a species from north to south.

Indian Common Wood-Shrike (Tephrodornis p. pondiceriana). 29, 76, 313.

'Constant resident in Pegu and breeds in March.' (Oates).

I found it fairly common in *indaing* jungle, nearly always high up in trees and in small flocks. Not seen in the Arakan hills where I only found *pelvicus*. A ♂, shot while singing, crouched flat on a branch, on March 29, 1929, was undoubtedly breeding. It had a shrill warbling song.

[These are nearest to the typical race.]

Burmese Scarlet Minivet (Pericocrotus speciosus elegans). 202, 367, 368.

Oates found it over the whole of Pegu. I saw several but collected few minivets and found them very hard to distinguish in the field. Two were obtained at 2,500 ft. in the Arakan hills where it appeared to be common and breeding.

[♂ w. 96, t. 90; 2 ♀♀ w. 88–92, t. 86–88. The male has the whole of the outer web of the central tail feathers red and the first three primaries lack the red spot. In the females the first three primaries lack the yellow spot.

The following races must be considered:—

fraterculus.—Described from Hainan. Eleven males thence w. 94–98. First two primaries plain in ♂, first three in ♀. Central tail feathers *wholly* black or occasionally edged with red on distal half of outer web. Out of over twenty males examined from Burma, only two have the central tail feathers black (one from Karennee and one from Kyoukkyo) but they agree with *fraterculus* in the spots on the primaries. These are what the older writers called *elegans* and I cannot unite them with *fraterculus* as is done in the *Fauna*, ed. ii.

flammifer.—Described from Pakchan (Bankasoon) in S. Tenasserim. Nine males thence w. 89–93, one 95·5. First *three* primaries plain in the male (two from Bankasoon, first two primaries plain); first four primaries plain in most females (first three plain in one 'S. Tenasserim' and two from Trang; first two primaries plain in one from Thayet District). Outer webs of central tail feathers in male *red* (except one). It will be seen therefore that *flammifer* from the type district is not quite constant in character. When, however, birds from Malay are examined, it is found that the tendency to shorter wings is more pronounced (none exceed 91 mm.; the red on the outer web of the central tail is constant and the first three primaries in males are always without the spot. It is unfortunate that *flammifer* was not described from N. Malay.

It will be seen therefore that the male from the Arakan hills agrees with *flammifer* in the spotting of the primaries but is rather large. The females however do not agree with *flammifer* in having the *first three* primaries plain instead of the *first four*.

Macclelland's *elegans* was obtained in Assam probably in the Khasia Hills. There seems no doubt that this bird of Macclelland's is the eastern representative of *speciosus*. The type, a ♂, has a wing of 97 mm. and a series from Dibrughar and the Khasia Hills measure 11 ♂ ♂ w. 95–102; the typical race from Sikkim ♂ w. 102–105; *elegans* then must stand for the Assam-Burmese race; somewhere it may grade into *fraterculus* as it certainly does into *flammifer* in the Peninsular of Burma, which again grades into *xanthogaster* further south still.]

Rosy Minivet (Pericrocotus roseus roseus). ♂ 173.

'Abundant over whole of Pegu' (Oates). Henricks obtained a male at Prome on 16th February.

[This bird is in heavy body moult. The moults of all the minivets require study. Apparently *roseus* has an ante-nuptial moult though I do not think all minivets have; another point which requires elucidation is—in which of the Minivets do the males breed in the female dress?]

Burmese Small Minivet (Pericrocotus peregrinus vividus). 147.

'Throughout Pegu and Arakan.' (Oates). I shot one out of a large mixed party on 11th February in *indaing* jungle, which included Ioras, *Hemipus picatus* and *Sitta neglecta*.

[A female on 11th February shows slight moult on the throat.]

Siamese Large Cuckoo-Shrike (Graucalus macei siamensis). 4. 208.

Common in certain localities in the plains in sparse tree-jungle. I did not see it at all in the Arakan hills in April, though Oates procured it there. It is partial to peepul-trees, and when three or four birds are chasing and fighting each other round one of these, they much resemble in flight, notes and habits ? the British Missel-Thrush (*Turdus viscivorus*). I have occasionally seen it feeding on the ground.

Pale Grey Cuckoo-Shrike (Lalage melachista siamensis). 139.

Oates describes it as spread over the whole of Pegu.

The only ones I saw in Prome were a ♀ shot in the Arakan foot-hills, west of Tonbo, on 7th February and one or two seen in the hills at 2,400 feet in April, 1929.

Ashy Swallow-Shrike (Artamus fuscus). 113.

Common and probably resident. The one shot at Tarokmaw was in a flock apparently feeding on insects on a *letpanbin* (cotton tree) in flower. Not seen breeding.

Black Drongo (Dicrurus macrocercus). Burmese :—*hnget-taw*. 9.

Oates considered this bird to be a migrant in Pegu from October to January, and in 'the other months it is either absent or very rare'. With this view I agree. I did not see any in the Arakan hills in April.

[A female w. 142, t. 163, on measurements might be one of four races: *cathœcus* is the form recognized in Central Burma.

Burmese Grey Drongo (Dicrurus leucophæus). 73, 228.

Common in the cold weather in teak and *indaing* jungle. Oates considered it a resident. Specimens were obtained at Kandin on 24th January and at Ngaphaw on 27th February.

[A male from Ngaphaw off 27th February, w. 143, t. 154, fork 54; a female from Kandin, 24th January, w. 135, t. 145, fork 50. Both these birds are the Pale Ashy Drongo. A great deal more work is required over the Drongos of India and Burma before the races and their distribution can be understood and it would be useless and misleading to attempt to give these birds a trinomial name.

Mr. Stuart Baker on the one hand and Messrs. Robinson and Kloss on the other have attempted to solve the problem and have both come to entirely different conclusions. Mr. Baker finds that there is only one Ashy Drongo, extending from N. W. Himalayas to South India and to Java, which can be split up into races on average length of wing and tail and that coloration—dark or pale—is of little moment. Messrs. Robinson and Kloss consider, as did Hume and Oates, that there are two species, the Dark Ashy Drongo *longicaudatus* and the Pale Ashy Drongo *leucophæus*, both of which over these areas have races. As regards this question, I would remark that, so far as I have seen—a fair series—Drongos vary in size according to sex, and it is therefore perfectly useless dividing up races on average measurements of unsexed or incorrectly sexed specimens. What we want as regards Burma is a good series of correctly sexed breeding birds and winter birds from various places together with field notes as to whether the light and dark forms exist side by side or whether one form is a winter visitor.]

Bronzed Drongo (Chaptia æenea æenea). 67, 68, 325, 388.

Very local. Henricks shot two at Kandin on 24th January and several were seen. Another was obtained at Sinde on the west bank of the Irrawaddy on 15th March. This Drongo appeared to be the only one at all common in the Arakan hills in April 1929 where it was breeding.

[♂ Arakan hills, w. 118 t. 110; three from Kandin and Prome, w. 118–126 t. 115–123. A topotypical series of *ænea* measure w. 113–130 and of *malayensis* w. 105–118. These Prome birds are therefore nearer the typical race.]

Burmese Large Racquet-tailed Drongo (Dissemurus rangoonensis). 28.

Common.

[I can confirm Mr. Salim Ali's observation that the racquet at the extremity of the outer tail feathers is formed by the inner web and that the shaft of the feather is twisted in its long axis.]

Indian Hair-crested Drongo (Chibia hottentotta hottentotta).

Oates (i. 227) found it abundant north of Prome and at Nyaungchidauk at the foot of the Arakan Hills. I did not obtain it in April 1929.

Eastern Great Reed-Warbler (Acrocephalus arundinaceus orientalis). ♀♀ 107, 298.

I shot a ♀ at Kyithe on 2nd February on the Letpanbu jheel and another on 22nd March. It appears from Oates to be a winter visitor only. Both those I shot were great skulkers.

Schrenck's Reed-Warbler (Acrocephalus bistrigiceps). 148.

Oates described it as common. I shot a male on the Letpanbu jheel on 1st February, 1929, and saw several others, exceedingly shy.

Indian Tailor Bird (Orthotomus sutorius patia). ♂♂ 64, 404.

In this part of Burma it is a most inveterate skulker, never seen outside dense bamboo clumps, and, except for its note, would rarely be observed. I got one in the Arakan hills at about 2,000 ft. in April.

Streaked Fantail Warbler (Cisticola juncidis cursitans). ♂ 58.

Extremely common along the Irrawaddy valley.

Franklin's Wren-Warbler (Franklinia gracilis). ♂ 75.

Probably common. The only one shot was out of a travelling party in bamboo jungle near Kandin on 24th January 1929.

Beavan's Wren-Warbler (Franklinia r. rufescens). 30, 198, 264, 334, 336.

Oates describes it as common at the foot of the Arakan hills on the eastern side. I obtained birds on an island north of Prome in high grass on 22nd February, two near Paukkaung in January and March, and two at 3,000 ft. in April 1929 near Nyaunggyo, where in the grass of the open jungle it appeared to be not uncommon.

[The two birds from Nyaunggyo on 3rd April are undergoing a complete moult. The January bird from Paukkaung is a juvenile.]

Striated Marsh-Warbler (Megalurus palustris palustris). ♂ 37. ♂ 145.

Very common in the Irrawaddy valley, (Oates saw it at Thayetmyo) where it breeds. The only nest found by me contained 3 incubated eggs on 30th May.

It was in an isolated tuft of grass on the bank of a paddy field. It breeds in some numbers in the south of the district in the big pea-fields near Letpankaya. Probably resident.

Thick-billed Warbler (Phragmaticola ædon). ♂♂ 137, 185.

I shot a single bird skulking in scrub jungle, west of the Irrawaddy near Tonbo on 7th February, and another single bird near Prome on 17th February, also exceedingly shy. Both these were far from water on dry hillsides. It is noteworthy that Oates usually found it near water and not a skulker.

Burmese Yellow-bellied Flycatcher-Warbler (Abrornis superciliaris subsp. ?) ♀ 348.

Oates says he got this bird in various parts of Pegu but that it was rare. I shot a ♀ at Nyaunggyo at 2,400 ft. on 3rd April, 1929.

[The types of *Abrornis superciliaris* came from Tenasserim and not, as Mr. Stuart Baker states in the *Fauna*, from the Himalayas. The latter bird should be called *flaviventris*, Jerdon, type loc., Sikkim. *Salwinensis* of Baker becomes a synonym of *superciliaris*. This single bird from Arakan does not quite match *flaviventris* or yet *superciliaris* as exemplified by series from the type localities. Possibly a distinguishable race inhabits Arakan. The series from Burma in the British Museum is not good.]

Burmese Wren-Warbler (Prinia inornata burmanica). Local name : *Hnget-letmat*. 38, 94, 132, 194.

Common along the Irrawaddy valley.

[The tail measurements of these four birds obtained in January and February range from 55·5 to 77 mm. considerably longer than that given in the *Fauna*. I may here note that in the latter work the type locality of *Prinia inornata blanfordi* is given as Thayetmyo ; it should be Tounghoo.]

Yellow bellied Wren-Warbler (Prinia f. flaviventris). ♂ 140.

Paired and singing in its breeding quarters by early February, the favourite haunt being the huge stretches of *kaing* grass on the Irrawaddy islands. I have seen nothing to indicate that the snapping sound is made by the wings as suggested in the *Fauna*. The few well-known birds which clap their wings, e. g., Nightjars and the Long-eared Owl, produce a very different type of sound by this means.

[The 'snapping' noise is made by several species of *Prinia* and appears to me to be made by the bill.]

Fairy Blue-Bird (Irena p. puella). 332, 347, 348, 366.

Oates found it in evergreen forest on the Pegu hills but 'not on the western slopes'. I found it only in evergreen forest at 2,400 ft. in the Arakan hills where it was common, though very shy.

[One male on 3rd April in full female dress. Here and there on the head and body there are adult feathers (blue) in quill, the result of accidental loss of feathers of the old dress. Birds which live in heavy jungle may frequently lose odd feathers by accident and in the case of those which are still in immature dress, the replacing feathers are those of the adult plumage. This I believe to be the explanation of these mixed plumages seen often in *Irena Pericrocotus*, *Hemipus* and others, and there is no reason to suppose a colour change without moult to explain it.]

Burmese Black-necked Oriole (Oriolus chinensis tenuirostris). Local name : *Hnget-wa*. ♀ 10, ♀ 126.

Oates did not find this in the 'dry parts of northern Pegu' and considered it a winter visitor only. Both those obtained by me were in the cold weather, but without shooting a large number it was difficult to distinguish species.

Indian Black-headed Oriole (Oriolus xanthornus xanthornus). 104, 276, 284.

Common and apparently resident.

[A male on 1st February has the throat and chin grey, streaked with black, and the wings and tail not so pure and bright as in the adult. Probably a bird of the first year.]

Maroon Oriole (Oriolus trailii).

Oates received it from Arakan. I never saw it.

Indian Grackle (Eulabes javana intermedia).

Not common and seen principally by me in pairs in the hills between 1,000 and 2,000 ft. Frequently kept by Burmans as a cagebird. I did not collect any.

Assam Spotted-winged Stare (Psaroglossa s. assamensis). 119.

Henricks shot a ♀ at Tarokmaw on the Irrawaddy on 4th February 1929. I have never seen it and think it must be rare. Oates never saw it and records it from only two places in the Pegu Division.

Grey-headed Myna (Sturnia malabarica nemoricola). 3, 97, 253.

Usually seen in small parties in tree-tops from November to March. Usually seen feeding in a mango tree. I shot another solitary bird in March coming to roost in bushes with large numbers of Pied-Mynahs in the Nawin marshes. Not seen breeding nor in the Arakan hills in April.

[One of these birds, quite an adult otherwise, has the winglet and primary coverts black instead of white. Such variations in *nemoricola* have several times been recorded.]

Jerdon's Myna (Gracupica burmanica). 195, 418.

Oates described it as ' very abundant in Northern Pegu,' and resident. I saw very large flocks on 17th April on the Irrawaddy near Prome. Quite common.

Common Myna (Acridotheres t. tristis).

Common. Breeds in March.

Indian Jungle Myna (Æthiopsar f. fuscus). 124, 252.

Common. I saw several flocks apparently on migration on the Nawin marshes in March.

Burmese Pied Myna (Sturnopastor capensis superciliaris). 121.

Common. I failed to observe its migration. Oates describes it as ' more or less absent from the Thayetmyo area in October and November.'

Baya (Ploceus philippinus). Local name: *Să-pōngyi.* 218, 219, 220.

Three were shot by Henricks out of a flock at Ngaphaw on 27th February on a large tank close to the village. I regret very much that I did not collect any breeding birds but Oates describes *Ploceus baya* as being abundant all over Burma, and this was apparently the bird he meant. I saw at least two species of Baya breeding in vast numbers in a large reed-bed on the Nawin marshes just north of Prome in the rains.

[There is not the slightest doubt that these birds, in non-breeding dress, are *not passerinus*. They are very pale birds and can be matched with birds from Sind and Ceylon in similar dress. wg. 69-71. The *Fauna* does not admit *P. philippinus* as an inhabitant of Burma. It is to be hoped that Mr. Stanford will be able to procure some breeding birds from this colony. There was in the past considerable confusion over the names of the Bayas, which even to-day is not entirely cleared up. According to Hume, *Ploceus baya* was the Eastern Baya now called *Ploceus passerinus passerinus* Reichenow. Oates (*Fauna*, ed. i) used *P. baya* for the Indian Baya and the mysterious *P. megarhynchus* of Hume for the Eastern Bayas. The latter, however, Mr. Baker considers to be a third species. Unfortunately *Ploceus passerinus* is a pure synonym of *Ploceus baya* (*vide*—Horsfield and Moore's catalogue.]

Golden Weaver-Bird (Ploceëlla chrysæa). 43, 44.

Two birds obtained out of a flock on stubble near Prome close to the breeding colony mentioned above on 20th January were of this species. Oates found it abundant but local in Southern Pegu.

[Just finishing a complete moult.]

Burmese Striated Weaver-Bird (Ploceus manyar flaviceps). 87.

One obtained at Prome on 27th January, 1929, out of a large flock on the Nawin, close to the breeding-ground mentioned above.

[This bird does not look like an abnormality; it certainly, however, does not tally with the dark richly coloured *peguensis*. It is exactly like Sind birds in similar dress which I have called *flaviceps*. This latter race was described from Southern India and the series thence in the British Museum is such a poor one that I do not feel satisfied that the Sind birds differ from it, hence I use the older name; if the two races should prove to be distinguishable, the Sind bird must be called *striatus*.]

White-backed Munia (Uroloncha striata subsp. ?). 386.

The only place where I saw this bird was between 2,000 ft. and 3,000 ft. along the Taungup road in the Arakan hills in April 1930, where it was in considerable flocks feeding on a flowering weed and in bushes along streams. On being disturbed, the flocks would fly round and suddenly settle and disappear in the dense growth. Oates describes *Amadina striata* (B. B. i. 365) as being recorded by Blyth from Arakan.

[This munia too is very puzzling, and I cannot match it with any race. It is blacker on the head and ear-coverts than any Burmese bird and in this respect is quite like the South Indian bird. However, unlike the latter, it has a grizzled and not a pure white abdomen. More specimens from the Arakan Hills are needed.]

Burmese Spotted Munia (Uroloncha punctulata subundulata). ♂ ♀ 186, 187.

This bird is not uncommon, but I did not collect a series. It is partial to breeding in houses and gardens, especially in bushes. Roosts in bamboo and is probably resident.

Burmese Red Munia (Amandava flavidiventris).

I saw a flock near Nyaungsaye in January 1929 near the Irrawaddy, but otherwise did not notice it.

Burmese House-Sparrow (Passer domesticus nigricollis). 289.

In my opinion *P. montanus* is the common sparrow of the district, and one that mainly frequents houses. In some dak-bungalows, notably Padaung, both House, Tree and Pegu Sparrows all breed in a colony. Oates remarks that *domesticus* was outnumbered by the next species in most parts of Burma.

[If the Burmese House-Sparrow is not different to the South Indian, then *nigricollis* of Burton is an older name for it than *confucius*.]

Indian Tree-Sparrow (Passer montanus malaccensis). 287, 288.

As Ticehurst remarks, this sparrow is really the House-Sparrow of the east. In the hot weather it feeds largely on flies and insects, and comes into houses with great familiarity. Does not seem in this district to be ousted by the House-Sparrows. Stuart Baker (iii. 177) confines *malaccensis* to the hills of Burma, whereas it is very abundant in the plains. A male shot at Padaung in March was killed while sitting with a female *flaveolus*. I should not be surprised if they occasionally inter-breed.

Pegu House-Sparrow (Passer flaveolus). ♂ ♂ ♂ ♀ ♀ ♀ 221, 222, 223, 224, 290, 306.

Oates describes it as 'comparatively' rare except about Thayetmyo. This is now a very common bird in the drier parts of the district and the Irrawaddy valley. It breeds in large numbers in certain dak-bungalows, notably Paukkaung and Padaung, and in company with *domesticus* and *montanus*. In November 1927 and again on 24th March 1928, I saw flocks apparently on passage near Prome.

Grey-headed Bunting (Emberiza f. fucata).

Oates recorded it from between Toungoo and Thayetmyo. I did not obtain it.

Little Bunting (Emberiza pusilla). 133, 135, 392.

Oates has no record of this bird from the Pegu Division or Arakan, and Stuart Baker describes it as a Tree-Bunting, not uncommon in the Assam foothills. I am inclined to think that all those obtained by me were on migration. On 6th February, 1929, I shot one out of a pea-field near Tarokmaw on the Irrawaddy, thinking as it rose that it was a Red-throated Pipit. On 7th February, I got another single bird near Tonbo, 10 miles further up the Irrawaddy, in a stream running through dense jungle. On 9th April I shot one in the Nyaunggyo stream at 2,400 ft. out of bushes, and on 10th April got one out of a small party on the Arakan side of the Taungup Pass on a grass covered hillside at 3,000 ft. I should think that this bird was easily overlooked. It reminded me of a very small Lapland Bunting in appearance.

Yellow-breasted Bunting (Emberiza aureola). Local name : *Sa-ni*. 23, 46, 101, 157. 196, 271, 301.

Extremely common from November to March in very large flocks. Roosts in bushes. Large flocks seen as late as the third week in March, though Oates records that they stay till May. On 24th March, 1928, I saw large flocks along the Irrawaddy apparently on passage. Occasionally a very big movement of these birds to roost at dusk may be observed as in the case of Swallows.

[The males on 23rd March are moulting the feathers of the face ; the yellow supercilium, dusky and yellow ear coverts and forehead and yellow chin of winter become black. No moult elsewhere. 6 ♂♂ wg. 73–80 ; 2 ♀♀ 72–75.]

Chestnut Bunting (Emberiza rutila). 13, 338, 359, 377, 378, 397.

Oates recorded it on the authority of Hume, and never apparently met with it. He mentions that it was the 'common bunting of the higher Karen hills.' I only met it twice. On 17th January, 1929, I shot one out of a small flock in teak jungle near Paukkaung (100 ft.) on the edge of the forest reserve. In April 1929, I found it very common at about 2,400 ft. near Nyaunggyo. All I saw were feeding on the seeds of the Telegu bamboo (*Dendrocalamus longispathus*), and, on being disturbed, disappeared into high tree-jungle. On April 11, I followed the direction taken by flocks in the late afternoon and found several hundreds congregating to roost in a deep hollow, full of bushes and rough grass, alongside the Taungup road, every bush being full of them. A good many Tree-Pipits were roosting in the same place. In appearance and flight these birds, when feeding, reminded me much of Lesser Redpolls and are unlike other buntings in their partiality for trees.

[These Buntings in the first week of April are also moulting the face. One male, presumably of the previous year, differs from the adult in having the mantle olivaceous with dark brown central streaks and the greater coverts brown with olivaceous edges which parts in the adult are chestnut. 4 ♂♂ w. 73·5–77, 2 ♀♀ w. 67–70.]

Crested Bunting (Melophus melanicterus). ♀ 389.

I shot a female on 10th April, 1929, at about 3,000 ft. about 3 miles east of the Taungup Pass on the road, the only one ever seen by me. Oates never met it in the Pegu Division though it was recorded by Blyth. I doubt if it will be found in the district except along the summit of the Arakan Hills.

Indian Sand-Martin (Riparia paludicola chinensis).

Breeds in very large numbers along the Irrawaddy and larger streams running into it. It certainly breeds from December onwards and probably throughout the cold weather. I did not collect any ; so am unable to say if *ijimae* also occurs.

Eastern Swallow (Hirundo rustica gutturalis). 60, 170, 171.

Oates says he saw nothing to suggest that this bird bred in Burma. Nor have I. It is found in very large numbers from September to April mainly along the river in Prome.

[Wings 108·5–115. On 17th February, one bird is performing a complete moult.]

Striated Swallow (Hirundo rufula japonica). 239, 240.

I shot 2 or 3 Striated Swallows and saw many others resting on the sands near Shwedaung on 3rd March, 1929, two in juvenile plumage being obtained. One or two were seen near Nyaunggyo in April 1929, apparently on migration, [As I have already pointed out (*B.N.H.S.Journ.*, xxxii., 1,p. 350), Red-rumpde Swallows of the *nepalensis* type wintering or on passage in Burma are rather larger and rather more heavily spotted than the Himalayan breeding birds, and the name applicable is *japonica*. These three birds from Shwedaung are in full moult; w. 116·5–123 and on the whole are more heavily streaked than *nepalensis*. They are too small and not heavily streaked enough for *striolata*.]

White Wagtail (Motacilla alba leucopsis). 117.

Common throughout the cold weather. No signs of any breeding. In early February 1929, a considerable number of single males were seen in the Irrawaddy valley, apparently on migration. I saw large numbers flocking to roost on the Sidaing Stream at dusk in February 1928 in an area where only scattered birds could be seen by day.

[A single bird obtained on 4th February is moulting the body feathers, two central pairs of tail feathers and the lesser and median wing coverts.]

Eastern Grey Wagtail (Motacilla cinerea caspica).

Fairly common all over the district in suitable places from September to March or April. I did not collect any. Never seen except singly or in pairs. A newly-arrived migrant appeared in my garden at Insein, far from water, on 29th September, 1929, and another in my garden at Prome in late September 1927.

Grey-headed Wagtail (Motacilla flava simillima). 36, 126, 303.

One yellow wagtail in this district is very common and arrives in immense numbers in September and stays till March. Nearly all I have watched on the ground appear to have no supercilium and to be extremely dark if not black on the head, lores and ear coverts throughout the winter. Once in October I witnessed a most remarkable movement of these Wagtails northwards along the river at Prome, hundreds high in air, flying presumably to some roosting place.

[These three Wagtails of the *flava* group are about as bad as they could be for identification work; one is unsexed, one almost certainly sexed wrongly, and all three are in very abraded dress. They are certainly near *simillima* with dark slate heads and ear coverts, one has a narrow white supercilium, while in another this is yellow, in the third absent. Fresh plumaged birds are required for proper identification. All these three birds have longer bills than *thunbergi* and have a characteristic of *simillima*.

Yellow-headed Wagtail (Motacilla citreola citreola). ♀ 146.

Not uncommon but nearly always found singly on the large swamps and jheels of the Irrawaddy valley in the close vicinity of water. Oates (i. 193) did not meet with it and records only one specimen from Papun. I saw one as late as 11th April, 1928, near Okshitpin in the Arakan foot hills.

Forest Wagtail (Dendronanthus indicus). 227, 251.

Only seen by Oates once or twice in the Pegu Division. I think it is easily overlooked on account of its very weak note and its habit of sitting still close to an intruder. In three months I saw specimens in several widely distributed places; on 24th February at Padinbin, and again on 27th February at Ngaphaw, both in the Pegu Yoma foothills. I obtained one out of a pair on the edge of the Irrawaddy in thin scrub jungle on 6th March and saw another on 17th April in the same place. On 10th April, at about 3,000 ft. near the Taungup Pass, I saw one or two, which, from their excited manner, appeared to be breeding. On the ground this bird creeps about and looks much more like a Pipit than a Wagtail, and when disturbed usually flies up into a tree. It is common in the Insein district within a few miles of Rangoon.

[A bird on 27th February is moulting on the chin and throat. This curious bird exactly bridges the two genera *Motacilla* and *Anthus* and if the genus *Dendronanthus* were dropped, there would be little ground for keeping the other two genera separate. The tail in the Forest Wagtail is short but not shorter than in *M. flava pygmæa*. The central tail feathers are shorter than the rest and are differently coloured, as also in the Pipits. The hind claw resembles that of the smaller Pipits more than that of a Wagtail. The plumage generally is much more reminiscent of a Wagtail, especially *M. capensis*, than of a Pipit.]

Richard's Pipit (Anthus richardi richardi). 39, 40, 47, 134. Local name : *Sâbadi.* I shot numerous specimens on open ground and in *Kaing*-cultivation all along the Irrawaddy valley, it being partial to dry sandy areas. Its great size, sharp single note and flight are most noticeable. I have no reason to suppose it breeds. Oates remarks that he does not recollect ever seeing any near Prome and Thayetmyo. I should say it was a winter visitor in fair numbers from September to March.

Indian Pipit (Anthus rufulus rufulus). 93.

Oates describes it as very abundant 'except in the dry northern parts near Prome'. In my opinion it was commoner in the dry parts of the district, particularly in the islands of the Irrawaddy valley. I did not observe it breeding.

Red-throated Pipit (Anthus cervinus). 41, 55, 56, 131, 302.

Very common from January to March along the Irrawaddy. All I saw were on *kaing*-cultivation or along the edges of the sheets of water left when the river falls, in fact, of all the Pipits, this was the only one I saw constantly frequenting wet sand. On the wing it is noticeably dark and has a strong flight, much reminiscent of the Lapland Bunting. Did not seem to mix with other birds, nor did I see it in the Arakan Hills.

Indian Tree-Pipit (Anthus hodgsoni hodgsoni). 17, 18, 47, 250, 272.

Very common from mid-September to the end of March and found all over the district. It is generally in small flocks, under the shade of trees, flying up when disturbed. I saw a very large flock at Nyaunggyo (2,400 ft.) during the first week in April 1929, apparently on migration, and found a large number one night coming in to roost in a pit with *Emberiza rutila.*

[A bird on 20th March is moulting the body plumage and part of the tail. Birds obtained prior to this date shewed no moult.]

Indian Skylark (Alauda gulgula gulgula). ♂ 59, 88.

I never observed this bird except in ones and twos along the Irrawaddy valley; but judging by the number heard singing in the early mornings in January and February over the pea-fields in this area, it is fairly numerous. It is the earliest bird to commence singing, long before it is really light. It is noteworthy that *A. gulgula* was considered by Oates as 'apparently absent in the Irrawaddy valley from the head of the Delta up to the frontier,' which really means the Prome and Thayetmyo area. This bird starts to sing in mid-November.

[I cannot separate these two birds from the typical race and *peguensis* seems to be a synonym. The differences relied on by Oates (S. F. iii, p. 343), do not appear to be constant.]

Ganges Sand-Lark (Calandrella raytal raytal). ♀ ♂ 53, 54, 305.

Oates (i. 374) describes it as confined 'to the sandbanks of the Irrawaddy between Prome and the frontier.' I found it common throughout the riverain part of the district, and it will probably be found also south of Kyangin in Henzada and Tharrawaddy, at any rate in the hot weather. It is extremely tame and can be observed at any time scavenging among the debris just outside fishermen's huts. It is rarely seen in pea-fields and only on the barest, most open stretches of sand. I watched birds pairing and fighting in January, but failed to discover any nests. It would be interesting to know where the bird resorts to when the river is in flood and for forty miles every island and sand-bank is blotted out. Occasionally in December and January, I have seen parties of 20 or 30 apparently gathered for shade on the edge of a steep bank just above high-water mark.

Burmese Bush-Lark (Mirafra assamica microptera). ♂ ♂ 8, 322.

This bird is as local as the English Wood-lark and replaces *Alauda gulgula* in the drier northern part of the district wherever there are trees, fallow and bush-jungle. I saw no signs of it in the Arakan hills. One or two shot by me had a curious swollen condition of the toes. Oates found it abundant at Thayetmyo and did not observe it anywhere else,

White-Eye (Zosterops palpebrosa palpebrosa). ♀ 394.

The only one obtained by me was at 3,000 ft. on 10th April, 1929, about a mile east of the Taungup Pass into Arakan out of a small party. This species was observed by Fielden at Thayetmyo (Oates i. 342), and *Z. simplex peguensis* has been found breeding near Thayetmyo.

Pegu Streaked Spider-Hunter (Arachnothera magna aurata). ♀ ♂ 203, 294.

Henricks obtained a pair at Theme in the Pegu Yoma foothills on 24th February, 1929. The only other Spider-hunters seen by me were a pair at 3,000 ft. near Nyaunggyo which I failed to obtain.

Mackenzie (S. R. iii. 417) found them 'by no means rare' in Prome and took nests in July and August 1918-19. Oates observed it at Thayetmyo.

[The typical form is recorded for Arakan; these two Prome birds are however certainly *aurata*.]

Burmese Scarlet-backed Flower-Pecker (Dicæum cruentatum ignitum). 31, 320, 321.

Very common. Specimens were obtained on 19th January and on 30th March on which date I got two out of a family party in a mango tree which had clearly only just left the nest.

[The juvenile plumage:—Upper parts dull olivaceous; upper tail coverts rusty red; underparts dull grey with a slight olive wash on the flanks; wings and tail black with very slight gloss; wing coverts and tertials edged olivaceous.]

Burmese Purple Sunbird (Leptocoma asiatica intermedia). 66, 192, 197, 353.

Not uncommon. I obtained several near Prome and one in the Arakan hills on 4th April, 1929, at 3,000 ft. out of a small flock.

The Malayan Ruby-Cheek (Chalcoparia s. singalensis).

Oates (i. 326) notes that he did not see it in Prome though it occurred in similar country east of the *Yoma*.

Pitta.

I saw no Pittas at all, though I was closely on the watch for them in Nyaunggyo in April 1929.

Blue-naped Pitta (Pitta nepalensis).

Oates's collectors (i. 412) got one 'on the Arakan hills near Nyaunggyo' so that the distribution in the *Fauna* (iii. 445) should probably be altered to include *South* Arakan.

Green-breasted Pitta (Pitta c. cucullata).

Oates found it plentiful on the *Yoma* between Thayetmyo and Toungoo, so it probably occurs on the Prome-Toungoo watershed.

Lesser Blue-winged Pitta (Pitta moluccensis).

Oates (i. 415) apparently had specimens brought him from 'Arakan' by his collectors.

Arakan Black-and-Red Broadbill (Cymbirhynchus affinis).

Oates obtained this bird 'near Nyaunggyo.' I saw no signs of it there and Broadbills were remarkably scarce in April 1928 and 1929.

Long-tailed Broadbill (Psarisomus dalhousiæ).

Oates observed it on the hills of the Thayetmyo-Toungoo border. It was only seen by me near Nyaunggyo in the Arakan hills, where in ten days careful search in April 1929, I only saw one bird and had another brought me on 7th April. I watched a pair building on 14th April, 1928, in evergreen jungle overhanging the Nyaunggyo stream. The nest was a huge bundle of black *hairs* (from what animal I know not, probably an ox) and fibrous roots hanging from the tip of a bough. Both birds assisted in building and were very parrot-like in their actions. One was exceedingly tame and sat near me swinging its tail like a Shrike. I saw another similar old nest on the same stream in April 1929 suspended from a bamboo tip.

(*To be continued.*)

PROPOSED CLASSIFICATION

OF

THE SMALLER INDIAN FIELD (*OR JUNGLE*) MICE.

BY

T. B. FRY, I.F.S., (RETD.)

The late Mr. Thomas when dealing generally with the Indian Mice (*J.B.N.H.S.*, xxii, p. 682, 1914), definitely separated the field from the house mice, and established a new genus *Leggadilla* in which he included some of the larger forms, and kept the genus *Leggada* to cover the remainder, but still left unsettled a very large number of the smaller forms, grouping them under the specific name 'booduga'.

The material available for study is now very considerable as specimens have been obtained by the Survey from many different parts of India and Ceylon. Burmah is less well represented as, with few exceptions, specimens from the region of Mt. Popa alone have been obtained. The object of the work now undertaken is to complete as well as may be that part of the classification of the smaller field-mice which Mr. Thomas left in abeyance, by admitting that earlier writers on the subject were fully justified in giving specific names to the comparatively few specimens they had to deal with, but which they knew were caught in widely separated parts of India, and might therefore reasonably be considered definitely different animals. In the first place it may be stated that all of these smaller field-mice, measuring say head and body some 75 mms. or less, with hind foot of 15 mms. or less and with a 10 mammæ formula, have a strong family likeness, no matter where they come from; and it is practically impossible to distinguish them by skull measurements, since though certain differences in size and shape may be apparent, yet they are confined within such small limits that they cannot be accepted as of specific value; consequently, strictly speaking, these mice should be separated on a sub-specific basis only. This, however, cannot well be accurately done owing to the difficulty in determining whence the species arose; whether for instance the animal first appeared in the north of India and spread southward or *vice versa*—hence there seems no valid reason for taking any particular recorded name as a specific one. It is true that *Mus* (*Leggada*) *booduga,* Gray. Charlesworth's *Mag. Nat. Hist.,* I, p. 586, 1837, appears to be the oldest name available and was adopted by Blandford and others, further, it is certain that the type made by Gray came from Southern India, very probably from Dharwar; on the other hand, the name *cervicolor* was assigned by Hodgson to a mouse presumably taken in Nepal in 1845. (*Mus* (*Leggada*) *cervicolor,* Hodgson, *A.M.N.H.,* xv, p. 268, 1845). These two mice, named quite independently, one from the South, the other from the North of India differ appreciably in general outward appearance and somewhat in size, also the skull of the former appears on an average to be smaller than that of the latter, yet which of the two, if either, should be accepted as typical of the species can only be a mere matter of opinion. At a date later than 1918, Mr. Thomas adopted the name *Leggada cervicolor,* Hodgs. for some mice collected in Nepal by Baptista thereby reversing his former view that *cervicolor* should be recognized as a synonym of *booduga;* accordingly it is now proposed to follow this procedure, and accept other specific names given by various authors, ignoring the fact that the field-mice from say Bengal are possibly of the same species as those found in Dharwar or elsewhere, but recognizing that owing to differences of climate, elevation and general environment, some slight but permanent modifications in colour and size have occurred, sufficiently noticeable to justify the adoption of different specific names for different local races.

The names, some of which it is proposed to utilize, are shown in Blandford's *Mammalia,* p. 416, as synonyms of *Mus booduga* and again in Wroughton's Summary under *Leggada, J.B.N.H.S.*, xxvi, No. 4, p. 959, 1920. General colour and average size in millimetres are shown under each heading.

DISTRIBUTION.

1. LEGGADA CERVICOLOR, Hodgs.

H & B. 66; T. 72; Hf. 18; E. 14·5.

Colour above, pale sandy brown, below, isabelline, fur rather long and somewhat woolly, dividing line not clearly defined.

Four specimens collected by Baptista in Nepal were found by Mr. Thomas to agree with a lectotype of Hodgson's *Mus cervicolor* and were recorded in Report No. 37, *J.B.N.H.S.*, xxix, No. 2, p. 422, 1923, under this name. No precisely similar specimens have been received from any other district, and therefore for the present the name applies only to the small field-mice of Nepal.

2. LEGGADA TERRICOLOR, Blyth.

H & B. 61; T. 58; Hf. 14; E. 11.

Colour above, dull earthy brown, below, white to isabelline, dividing line well marked in white bellied specimens, less so in those with isabelline bellies.

This name appears to be applicable to the lesser field-mice found in the following districts:—Bengal (the type locality) Bhutan Duars, Central Provinces, Gwalior, Berar and Nimar, and of these the fifty-eight specimens obtained by the Mammal Survey from Bengal may be considered as topotypical since the name was given by Blyth to specimens taken south of, and in the neighbourhood of Calcutta and also from Midnapur; moreover he noted it as the commonest field-mouse in Lower Bengal, and as being very abundant in the Santal Districts west of Midnapur. The area concerned is a very wide one, and conditions must vary considerably, still the general appearance, size and colour both above and below, of the mice from all these localities is so similar, that it seems unwise to attempt any further differentiation. Blyth (*J.A.S.*, xxviii, p. 296) gave the name *tytleri* to a mouse from Dehra Dun but the description tallies closely with that of *cervicolor* and possibly was identical with it; in any case the name does not seem suitable for the Kumaon specimens as they resemble those from N.W. Punjab much more closely than those from Nepal.

The difference between the 'earthy' brown colouring of *L. terricolor* and the 'sandy' brown of *L. cervicolor* is strongly marked, and in addition the fur of the former is much closer in texture than that of the latter which is made up of longish more or less woolly hair.

3. Leggada dunni, Wroughton.

H & B. 63; T. 61; Hf. 13; E. 11.

Colour above, drab, below, white to pale isabelline, dividing line usually clearly defined. Fur short close.

Mus (*Leggada*) *dunni* was separated from *booduga* by Wroughton in 1912—*vide J.B.N.H.S.*, xxi, p. 339. In Report No. 2, a single specimen obtained in Cutch by Crump was shown as *dunni* while in Reports Nos. 10 & 12 Kathiawar and Palanpur respectively, Wroughton observed that mice found in the open country showed the characteristics of *dunni* while those from hilly wooded country resembled *booduga,* consequently he recorded some under the one head, some under the other. The slightly darker hue of the upper coat, and the tendency towards pale isabelline, as opposed to pure white, below is clearly noticeable in some of the hill specimens from Kathiawar and Palanpur, but in no other respect is any difference apparent; therefore it seems reasonable and desirable to include all the small field-mice under one name. The type locality of *dunni* is N.W. Punjab, and the mice from Kumaon and Kangra Valley must also be placed in this category, although those from the latter are a trifle darker in colour both above and below.

4. Leggada nagarum, Thomas.

H & B. 75·5; T. 62; Hf. 14; E. 13.

Colour above, darkish brown, below, dark grey, fur moderately long, dividing line more or less indistinct.

Passing eastward again to Assam, further study of the specimens from this district which were classed as *L. booduga* in Report No. 41, has led to the conclusion that they should rightly be relegated to the above-named species, the type locality of which is the Naga Hills. Why these mice were not correctly named in the first instance is something of a mystery, since had they been carefully compared with the specimens named by Thomas, no doubt as to their identity could have arisen; probably the mistake occurred simply because at the time the Report was written the habit of calling all the small Indian field-mice *booduga* was then in vogue, and no comparison was made.

5. Leggada booduga, Grey.

H & B. 62; T. 57; Hf. 14; E. 12.

Colour above, fawn to light or darkish brown; below from pure white to pale or even darkish isabelline, varying according to local conditions, dividing line also varies in distinctness according to the hue of the under parts.

This name appears to be applicable, with a few exceptions, to all the small field-mice, i.e., with H. & B. of 75 mms. or less, found within the limits of Khandesh on the north, to Cape Comorin in the south; the exceptions being some specimens obtained by the Survey in Madura, Coimbatore and the Eastern Ghats.

Those found on the hilly forest-clad country of the Western Ghats differ to some extent in size, and colouration both above and below, from those coming from the plains of Dharwar, Coorg, etc., but these differences do not seem sufficiently pronounced to justify any splitting into sub-species. Moreover the variations can no doubt be fairly attributed to changes of environment, such as elevation, rainfall, soil, tree-growth, etc.

Specimens originally reported as *L. booduga,* and for which that name is still retained, were obtained by the Mammal Survey from Khandesh, Poona (including ghat country), Ratnagiri (Koyna Valley), Dharwar (presumably the type locality of *booduga*), Kanara, Mysore and Coorg. Skulls of specimens from the above-mentioned districts compared with typical Dharwar skulls (Dharwar being accepted as the type locality of *booduga*) showed only very slight differences in size and shape, thus furnishing additional justification for grouping them all under the one head.

6. Leggada palnica, Thomas.

H & B. 73; T. 66; Hf. 15; E. 13.

Colour above, darkish brown, below pale grey; dividing line not very clearly defined.

Eleven specimens obtained in Travancore were originally reported as *booduga* and the justification for using this name lay in the fact that their average size agreed more or less with that of some Deccan specimens; but closer examination shows that probably they are all rather immature, while their skulls are considerably larger than those of true *booduga;* again the slight differences from typical *palnica* in colour and texture of fur may be due to environment or seasonal causes; these considerations lead to the conclusion that they must be reclassified as *Leggada palnica.*

6. Leggada lepida, Elliot.

H & B. 67; T. 58; Hf. 15; E. 12.

Colour above, light sandy or fawn with a slight reddish tinge, a faint dark line down the back; below, white or pale isabelline, a small white mark below the ear, dividing line usually sharply defined.

The exceptions noted under *L. booduga* include specimens from Coimbatore (type locality) 5, Cape Comorin 4, Madura (High Wavy Mt.) 6, Eastern Ghats 35 and Bellary 18; of these the last two show only a mere trace of the white marking below the ear, but are otherwise similar to the two former, while all of them are clearly different from '*booduga*'; in connection with this white mark it should also be mentioned that most of the Eastern Ghats specimens are obviously immature.

The British Museum possesses no named specimens of *Mus* (*Leggada*) *lepidus,* nor again are there any authentic specimens in the Madras Museum; consequently direct comparison not being possible, identification depends entirely on Elliot's description, which is somewhat vague (*Mus lepidus,* Elliot, Madras *Journal L. Sc.,* x, p. 216); still in some essential points the Survey specimens appear to agree with it very closely. Although Elliot made no mention of the ear-mark noted above which is a very noticeable feature in the specimens from Coimbatore and Cape Comorin, yet this discrepancy in the description of 'lepidus' may well have been due to the non-existence, or very slight trace of, the mark in the specimens dealt with by Elliot. The type of *lepidus* is only known to have come from S. India, the exact locality not being recorded, so quite possibly it may have been taken in the Madura district where for some local reason this ear-mark may not have been developed; at any rate in the Survey specimens the mark is barely traceable. Blyth, it is true, considered *lepidus* to be a synonym of *booduga,* but he may have based his opinion on size alone, disregarding the question of colour and the delicacy of the limbs, two well defined distinguishing features.

7. MUS (LEGGADA) FULVIDIVENTRIS, Blyth.

H & B. 68; T. 65; Hf. 15; E. 11·5.

Colour above, darkish brown, fur short, smooth; below, mostly pale isabelline or even white, dividing line varies from sharp to moderately well defined according to the colour of the under parts.

Blyth described under this name (*J.A.S.B.,* xxi, p. 351, 1852) a mouse from Trincomali, N.E. coast of Ceylon, as affined to *Mus terricolor* except that it was larger and generally greyer or less fulvescent, and gave the length (H. and B.) as about two and three quarter inches and tail two and a half inches. The specimens obtained in Ceylon by Major Mayor, for which it is proposed to adopt the name *fulvidiventris* cannot be compared with Elliot's type as it is not in the British Museum Collection, but they tally with his description quite well both in respect to size and colour. The Survey specimens from Ceylon are somewhat larger, and differ appreciably in colour and texture of fur from typical *L. booduga* or *terricolor,* and assuming them to represent Blyth's mouse it would seem that he was fully justified in giving another name to his mouse from Trincomali, and further that in the present reclassification the adoption of his name, *fulvidiventris,* for the Ceylon field-mice, as a whole, appears to be equally well justified.

8. LEGGADA LEPIDOIDES, sp.n.

H & B. 69; T. 52; Hf. 14; E. 11·5.

Colour above, rather variable, some specimens being darkish brown on the back tending to a greyish brown on the sides and flanks, while others are paler with an ochraceus tinge; below, usually pure white, in some cases deepening to a very pale isabelline, dividing line well defined.

Looked at from above there is a marked resemblance to *L. terricolor* from the Duars, but the latter are invariably of much darker hue below. The reason for linking these mice from Mt. Popa with *L. lepida* from Madras lies in the fact that both of them have a small white spot below the ear. This mark is not quite so fully developed in the Burmese mice as in those of Madras, sometimes being only just visible; the character may not be an important one in itself, but it suffices to establish a sort of relationship between the field-mice of these widely separated areas. Moreover they do not differ greatly in average size, either in bodily or skull measurements :—in fact the Burmese skulls are practically indistinguishable from those of *L. lepida,* or *L. booduga,* therefore it is unnecessary to give actual dimensions. Whether the ear-mark arises from some similarity of local conditions in the two countries is a matter for conjecture, but the fact remains that it is only in specimens from these two regions that this peculiarity appears to be found.

Two *Leggadas* from Burmah have been described, one from the Salween Valley by Peters (*L. beavani, P.Z.S.,* p. 559, 1866), the other by Anderson from the Kakhyen Hills (*Mus Leggada*) *kakhyensis* or *viculorum* (*Zool. Yunn.* pp. 107, 108, 1878); but in neither case do they appear to represent the Mt. Popa specimens collected by Shortridge, either in general measurements or in colour, consequently it became necessary to rule out these names and establish a new species.

SOME BIRDS FROM THE NORTH WEST CORNER OF FARS, PERSIA.

BY

C. Erik Capito, O. B. E., F. Z. S.

(*With a Map*).

The following notes are on birds collected in an area at the north east end of the Persian Gulf between 1924 and 1928. Various friends contributed to the collection amongst whom were A. G. Lawson, G. H. Dawson and G. M. Gibson, but the majority of the birds were shot by either Baba Jan or myself. Except for the first year practically all the birds were skinned and prepared by Baba Jan, a Kashquli. I am very much indebted to Mr. N. B. Kinnear of the British Museum, Natural History for all the identifications and the correlations with Messrs. Witherby & Palmer's collections as well as for corrections to this manuscript.

The specimens consisting of a total of 460 skins of 138 species together with 74 clutches of eggs have been divided between the British Museum and the Society.

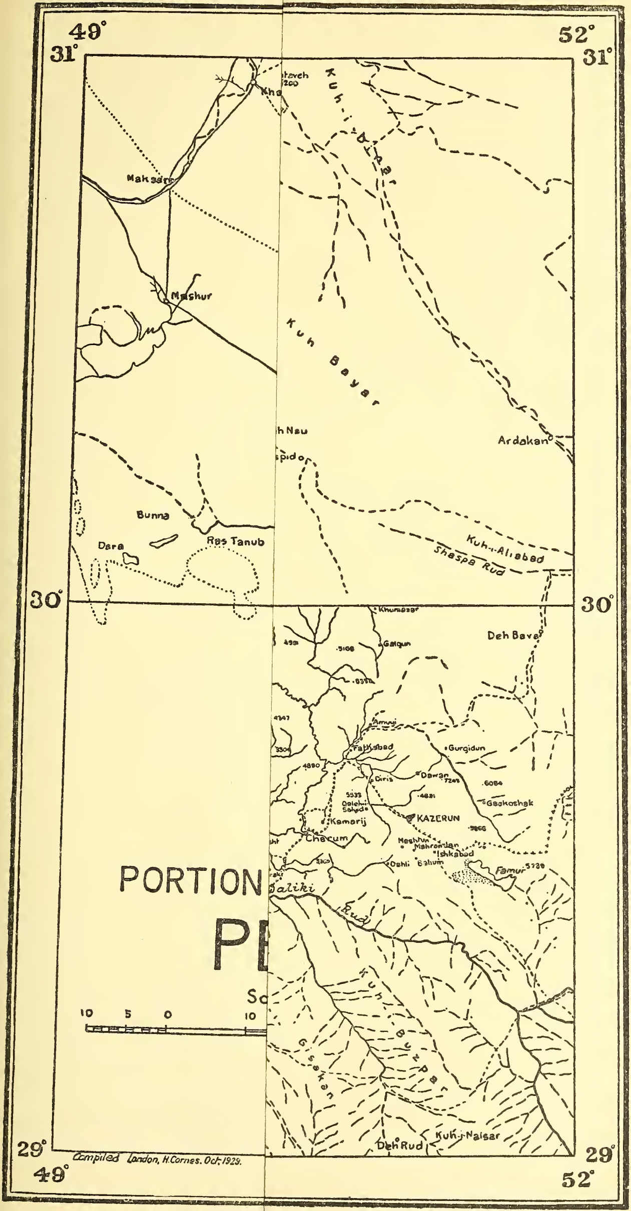
The undernoted papers describe birds from nearby areas :—

1. On a collection of Birds from Bushire in the Persian Gulf by R. B. Sharpe. *Ibis*, 1886, pp. 493-499. These birds were collected by J. V. Palmer from Bushire in 1885 and consisted of 83 skins of 53 species.
2. An Ornithological Journey in Fars, S. W. Persia by H. F. Witherby. *Ibis*, 1903, pp. 501-571 (Bushire, Shiraz and Diner).

The area in which the birds were collected consists of a portion of the N. W. corner of Fars and a portion of the southern end of Arabistan and is bounded by the Hindiyan river to the north as far as Deh Mulleh and then by a line across to the Marun river near Bebehan, from there it follows the high hills to the N. E. running N. W. and S. E. nearly to the Shapur river and then on the south by that river, which changes its name to Rudhilleh as it emerges from the hills into the coastal plains to enter the Persian Gulf ; on the west by the Persian Gulf.

The area consists of a coastal plain bordering the Persian Gulf which is about 10 miles wide, part of which consists of arable land, partly salt desert while close to the shore there are a few sand hills. On the desert section low tamarisk scrub grows in places, whilst near the villages, a few gardens growing vegetables with either or both date palms and tamarisk trees. Some of the latter must be very old judging by the girth of their trunks. Otherwise the plains are devoid of vegetation except in the spring months when wild flowers are in abundance and the local farmers grow, with the aid of a scanty rainfall, crops of wheat and barley. Between the Hindiyan and Rudhilleh rivers, several comparatively small streams flow from the foothills into the Persian Gulf their courses being cut into ravines 10-50 feet deep by 50-150 yards wide.

The foothills consist of alternate layers of yellow and reddish sandstones and mudstones weathered in some places into fantastic shapes, but, except for a very occasional stunted ' Konar ' tree, are devoid of vegetation, and even in the spring, the grass and wild flowers do not grow in such profusion as on the plains or in the higher valleys. As the land rises the sandstones and mudstones give place in parts to limestones and blue mudstones with here and there hills of gypsum with red and blue shales. At a higher stage these gypsum hills predominate but give way to massive limestones in the still higher ranges. However for the most part, these limestones are outside my collecting area. Between the ranges of hills there are fertile valleys but crops, with very few exceptions, such as along the Zeitun river and at Baba Kellu and Bikarz, are all rain fed.


49°
52°
31°
31°
Kha
Kuh-i-Dinar
Maksar
Mashur
Kuh Bayar
h Nau
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Bunna
Dara
Ras Tanub
Kuh-i-Alibad
Shaspa Rud
30°
30°
Khumazar
Galgun
Deh Bave
4991
5166
4347
3304
Amuji
Fahliyan
Gurgidun
4890
Dawan
7249
Giris
6084
5533
Qaleh-i-Safid
4831
Gaokoshak
Kamarij
KAZERUN
5866
Charum
Meshhun
Mahronjan
Ishkabad
Dashli
Balium
Famur
5739
Daliki
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Kuh-i-Buzpar
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Deh Rud
Kuh-i-Naisar
29°
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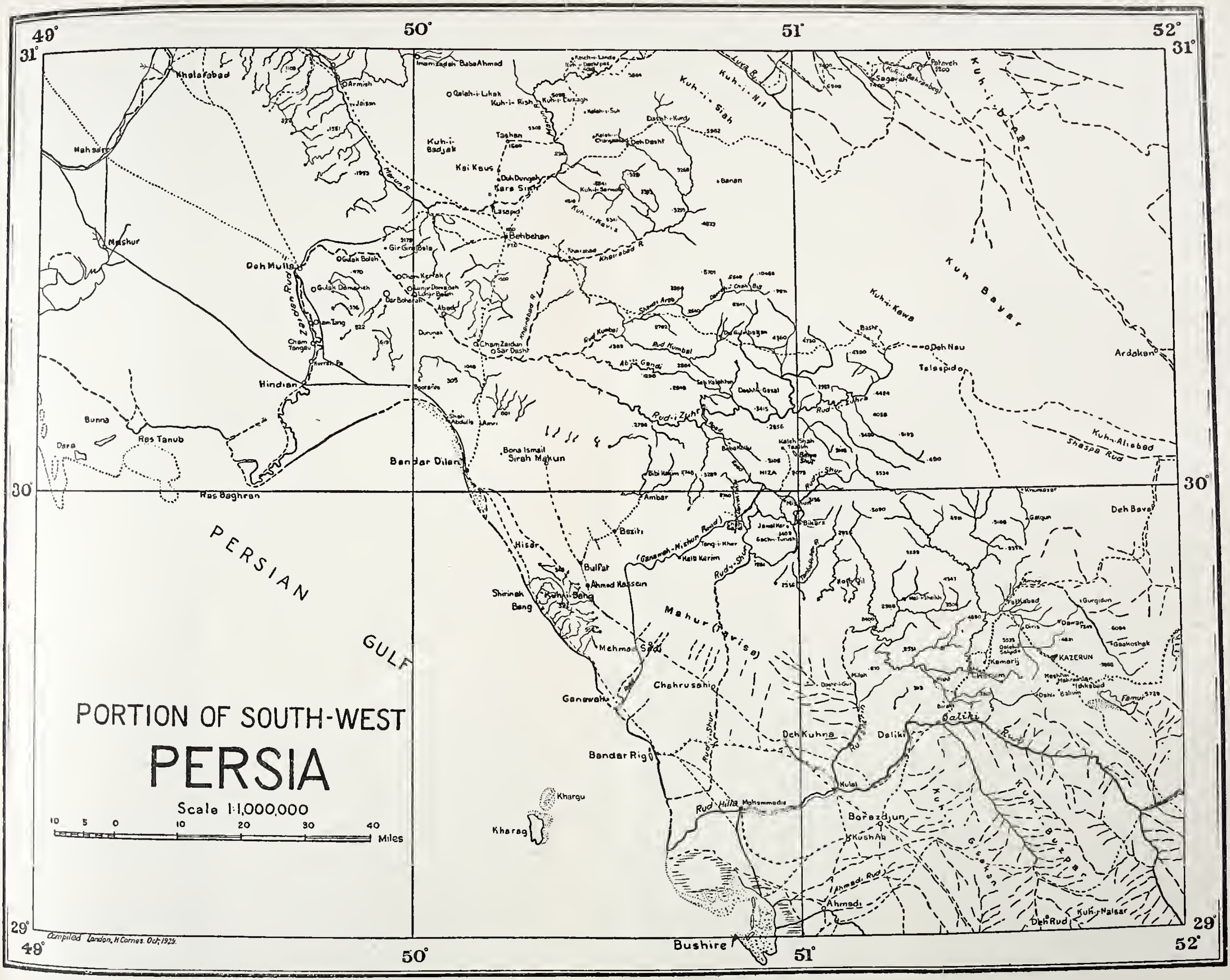
Compiled London, H.Cornes. Oct. 1929.



PORTION OF SOUTH-WEST PERSIA

PERSIA

Scale 1:1,000,000

Compiled London, H. Cornes. Oct. 1929.

49°
50°
51°
52°
31°
30°
29°
10 5 0 10 20 30 40 Miles
PERSIAN GULF
Khalafabad
Mah sar
Mashur
Deh Mulla
Zaidan Rud
Gulak Balah
Gulak Damaneh
Cham Tang
Cham Tangau
Hindian
Bunna
Dara
Ras Tanub
Ras Baghran
Gir Gira Bala
Cham Kerkh
Dar Boherah
Abad
Durunak
Cham Zardun
Sar Dasht
Imamzadeh Baba Ahmad
Qalah-i-Likak
Kuh-i-Badjak
Kai Kaus
Kuh-i-Rish
Tashan
Marun R.
Deh Dungah
Kara Sirh
Lasapid
Behbehan
Kheirabad R.
Khairabad
Kuh-i-Kavis
Kuh-i-Siah
Kuh-i-Nil
Luvra R.
Dasht-i-Kund
Deh Dasht
Kuh-i-Serunda
Banan
Kuh-i-Dinar
Patareh
Sagereh
Kuh Bayar
Kuh-i-Kawa
Bashr
Deh Nau
Talaspido
Ardakan
Kuh-i-Alisbad
Shaspa Rud
Shahar Arab
Rud Kumbal
Ab-i-Gandi
Sar Kalahtun
Dasht-i-Gazal
Rud-i-Zuhre
Rud-i-Shur
Shah Abdulla
Amri
Bandar Dilam
Bona Ismail
Sirah Makun
Bibi Hakum
NIZA
Ambar
Bazilı
Mishun
Bikarz
Jamal Kar
Sachn Turush
Tang-i-Khar
Kalb Karim
Ganaweh-Mishun Road
Tarbuzian R.
Kafr Gil
Hisar
Bulfat
Ahmad Hassain
Shirinah
Bang
Kuh-i-Bang
Mehma Sadi
Mahur (Tavise)
Chahrusahi
Ganaweh
Bandar Rig
Rud-i-Shur
Deh Kuhna
Daliki
Rud-i-Shapur
Kulal
Rud Hilla
Mohammadis
Borazjun
Kush Ab
Ahmadi Rud
Ahmadi
Bushire
Kharg
Khargu
Kuh Gisakan
Kuh-i-Buza
Deh Rud
Kuh-i-Nalsar
Daliki R.
Kamarij
Kazerun
Fahliyan
Gurgidun
Deh Bavar
Galgun
Famur
Dasht-i-Gur

The wild vegetation as the hills rise from the foot hills consists of widely separated clumps or single 'Konar' trees with wild almonds becoming quite frequent at about 2,000 ft. and at this height 'Ban' trees are to be found here and there, whilst stunted oaks start at about 3,500 ft. In the spring, wild flowers are in abundance and grass covers any place which has even a small amount of earth. Most streams that have perennial water are either bordered with bull-rushes or, if their beds are stony, occasional bushes of oleander and tamarisk grow either on the banks or in their beds. Along the banks of the Zeitun and Kheirobad rivers are big stretches of tamarisk and willow jungle, the home of the francolin, partridge and pig.

Depressions forming small lakes are occasionally found in the gypsum hills, the largest being the Bahm-i-Shur lake which is about a mile long by one-quarter of a mile at its greatest width.

Rainfall in the area averages 12·5 inches a year which falls between November and April with occasional showers in October and May. The winter temperature falls to a minimum of 26° F. at night with a day shade temperature of about 50 to 60° F. In the summer the climate of the 4 or 5 miles bordering the shores of the Persian Gulf is very humid with a maximum temperature of about 114° F. unless an offshore wind is blowing when the air is drier and the temperature rises accordingly. Further away from the coast the climate is drier with a rise in temperature which at some 10 or more miles inland may be as high as 127° F. in the shade. As the hills rise over 1,000 ft., the temperature does not rise so high and at 1,900 ft. the maximum temperature never exceeded 121° F. whilst the highest minimum temperature was 78° F. the average minimum temperature for July at this height was 75° F.

1. **Corvus corax lawrencei. Punjab Raven.**
Resident and common throughout the area.

2. **Pyrrhocorax pyrrhocorax Red-billed Chough**
Resident in the upper parts of the area more especially in the deep gorges of the Zuhra river. During the cold weather they descend lower down and large flocks were seen playing round the hill tops at about 1,600 ft. near Kilo Kerim.

3. **Sturnus vulgaris poltaratskyi. Finsch's Starling.**
A common winter visitor arriving in large flocks in the autumn—first seen October 20, 1924 and October 26, 1925—and leaving again in April or early in May. The local people eat the starling

4. **Oriolus oriolus oriolus. Golden Oriole.**
No specimens obtained but one was seen at a small waterfall near Bikarz Castle in May.

5. **Carduelis carduelis niediecki. Persian Goldfinch.**
Specimens were obtained in March 1927 near Mishun. I do not think they were regular visitors nor did they prolong their stay in the area though I saw others about the same time North of Shah Taslim.

6. **Fringilla cœlebs cœlebs. Chaffinch.**
A regular winter visitor to the hilly part of the area and examples were obtained on December 12th in the Tang-i-Mishun, February 5th at Shah Taslim and February 26th at Mishun. They appear to migrate North in March.

7. **Passer hispaniolensis transcaspicus. Eastern Spannish Sparrow.**
Local name: *Gungesh*.
Resident in the area. They breed in trees and buildings and make a great nuisance of themselves about bungalows. Eggs were obtained from March 29th to June 5th, on which latter date a quite fresh clutch was found. On April 6th, a nest was found in a Konar tree in which a wood-shrike also had its nest.

8. **Emberiza calandra calandra. Corn Bunting.**
Palmer obtained specimens near Bushire in February and March and Witherby found it fairly common from the coast to over 9,000 ft. further east. All my specimens were obtained in the cold weather, on March 6 and 21, 1924

February 11 and December 2, 1925 and February 16, 1926. A clutch of 3 eggs was brought in to me at Bikarz on March, 22, 1924, which appears to belong to this species.

9 **Emberiza melanocephala. Black-headed Bunting.**
Witherby describes this Bunting as 'the most evenly distributed and common bird' in the part of Persia which he visited. Palmer records a specimen from Bushire obtained in April and I got examples at Mishun on April 2, 1924 and on May 6, 1925. In my experience the Black-headed Bunting is a passage migrant passing through the area southwards between November 17 and 26 and on the return migration in the spring it arrives early in April—on the 6th in 1924, 8th in 1925 and 6th in 1926—and remains till the beginning of May when it continues its northward flight.

10. **Emberiza hortulana. Ortolan Bunting.**
Migrant—a single specimen was obtained at Mishun on April 18, 1926. Palmer shot an example near Bushire in April and Witherby one on April 30, near Nash-i-Bahram 3,300 ft.

11. **Alauda arvensis intermedia. Eastern Skylark.**
A single specimen was obtained, but unfortunately the label has been lost; and I do not remember where and when it was shot. Both Palmer and Witherby got single examples at Bushire in January and March 23, respectively.

12. **Calandrella brachydactyla brachydactyla. Short-toed Lark.**
Witherby found this bird very local and I did not meet with it often. A female was obtained at Ganoweh on January 11th, 1923.

13. **Ammomanes deserti fraterculus. Palestine Desert-Lark.**
This bird is quite common and a resident in practically the whole area though in fewer numbers on the plains. No nests were obtained. Witherby noted it as fairly common near the coast and found a nest at Kamarij (2,700 ft.) on March 20th.

14. **Galerida cristata magna. Hume's Crested-Lark.**
Local name : *Kul Kulatin.*
This lark occurs in large numbers throughout the area and is resident. The eggs are usually laid early in April, and the nest is made in a depression in the ground. One pair made their nest at the side of our tennis court at Mishun but abandoned it after laying eggs as tennis restarted then and they objected to being disturbed.

15. **Alæmon alaudipes doriæ. The Persian Bifasciated Lark.**
Resident in the lower part of the area along the sea coast and on the tidal banks of the Hindiyan river, they have also been noted on the Karun river between Marid and Dorquain where it is still tidal.

16. **Anthus sordidus decaptus, Brown Pipit.**
A male and female were obtained at Mishun on October 26, 1924, and a female near the same place on July 23, 1926, but otherwise I have no notes on this bird.

17. **Motacilla** sp. ? **Wagtail.**
A yellow wagtail of sorts was seen many times, but I was never able to secure specimens. In the autumn migration, it appears a little later than the White Wagtail and on the return passage they pass through earlier than that species. In 1926, a pair were seen on October 23.

18. **Motacilla alba dukhunensis. Indian White Wagtail.**
A winter visitor whose arrival in the autumn is a sure sign of the approach of the cold weather and likewise the departure indicates that the hot weather is at hand. This species arrives about October 6 and leaves again about the end of March,

19. **Sitta neumayeri dresseri. Large Rock Nuthatch.**
Local name : *Bulbul-i-Kuhi.*

Resident in the hilly part of the area where they are found in rocky gorges. No nests were found but young from the nest were brought in by the local inhabitants on April 20 and 24, 1925, and one of these was kept alive in my aviary till June 10. In one gorge where drilling went on regularly, these birds became so tame that they would come and sit on the steel structure and drink from a tank of water with men working alongside.

20. **Lanius excubitor pallidirostris. Allied Grey Shrike.**
Local name : *Alla Kardeh.*

Examples of this shrike were obtained at Bikarz (2,000 ft.) on October 5, 1924 and near Amiri (100 ft.) on September 1, 1926, but I have no notes as to when it arrives or departs.

21. **Lanius excubitor aucheri. Bonaparte's Grey Shrike.**
Local name : *Alla Kardeh.*

This shrike is probably a resident and adults were obtained at Bikarz (2,000 ft.) on October 5, 1924 and Mishun (1,900 ft.) January 9, and February 2, 1925. Two nestlings were brought in to me at Mishun in May of 1925 and 1927 which I put into spirit and another which I got in the same place, April 18, was reared in my aviary till it was fully fledged but unfortunately it died on May 13. The nests are in Konar trees and I obtained eggs on different dates in April.

22. **Lanius senator niloticus. Eastern Woodchat Shrike.**
Local name : *Alma Bash.*

A summer visitor arriving about February 22, and departing about September 15. Eggs were taken on the Niza plain near Mishun on March 29, at Gach Qara Guli on the Zuhra river also on March 29, and at Ab Garm on April 6.

23. **Lanius collurio. Red-backed Shrike.**

This shrike was generally to be seen in the plains near Ganoweh in March and April and a specimen was obtained there on September 2, 1926, but I did not meet with it in the hills though Witherby obtained a young bird near Ardekan (2,700 ft.) on May 26, and saw a fully adult male at Shiraz on April 30. Palmer shot an adult near Bushire in April.

24. **Lanius isabellinus. Isabelline Shrike.**
Local name : *Qissel Quoirukh.*

A summer visitor. I got an adult male at Ab Garm (1,700 ft.) on April 12, and a nestling which I take to belong to this species was brought in to me from Bikarz on April 19. Two young birds were sent home to the London Zoological Gardens where one of them lived some years. These had been obtained at Mishun as nestlings.

25. **Lanius cristatus phœnicuroides. Rufous Shrike.**
Local name : *Qissel Quoirukh.*

This shrike arrives in the spring and I obtained specimens as follows : Bikarz February 26, Bid-i-Zard April 12, Tang-i-Mishun June 12. I have no notes about its breeding.

26. **Lanius nubicus. Masked Shrike.**

A bird of this species was shot at Jamal-i-Khar near Bikarz on June 21, 1924.

27. **Pycnonotus leucotis mesopotamiæ. Mesopotamian White-eared Bulbul.**
Local name : *Bulbul.*

Witherby notes this bird as common between Bushire and Shiraz from March to May. I obtained specimens at Bikarz in the end of March and a young bird at Cham-i-Khal on May 13, 1924. This bulbul arrives in flocks about September 25, and leaves again early in June ; during this period it is found throughout the area from the hills to the plains. I did not find any nests but had three eggs brought to me which were taken on April 16, near the Zuhra river. It is a resident of the date palms of the Shatt-el-Arab and may also occur as a resident in the gardens of Bebehan.

28. **Phylloscopus** sub-sp. **Chiffchaff.**

Only one specimen of this was obtained at the Bahmi-Shur lake on February 7, 1926.

29. **Sylvia communis icterops. Eastern Common White-throat.**

I procured this bird near Mishun on May 2 and September 24, and at Ganoweh on October 1. Witherby says it was local and not common.

30. **Sylvia curruca curruca. Lesser White-throat.**

A single example of this white-throat was shot on March 12 at Shah Taslim. Palmer procured two examples at Bushire in April.

31. **Scotocerca inquietus striatus. Streaked Scrub Warbler.**

A male example of scrub warbler was obtained on August 8, 1929, at Gach Qara Guli 2,600 ft. and sent to me.

32. **Agrobates galactodes familiaris. Grey-backed Warbler.**

On May 6, Gibson shot a female off her nest containing four fresh eggs in a Konar tree near Mishun whilst Baba Jan got one at Baba Kellu on July 22, 1926.

Witherby noted it in all the fertile plains between Bushire and Shiraz and Palmer obtained a male and female with nest and eggs near Bushire in April.

33. **Argya caudata huttoni. Afghan Babler.**

Local name : *Dum Diraz* or *Uzem Quoirukh* or *Leecu.*

A resident and breeding from March to April in low bushes. It lays three to five greenish blue eggs in a cup-shaped nest of grass in a bush. Several of these birds were kept in my aviary and did very well. I noted it only in the hills.

34. **Turdus atrogularis. Black-throated Thrush.**

Winter visitor. A specimen was caught alive on January 20, 1925, but died a few days later. Palmer obtained two females at Bushire on February 16 and March 4.

35. **Monticola axitalis. The Rock-Thrush.**

A single example of this thrush was shot near Mishun on January 25, 1925. Palmer obtained a male at Bushire in March 1885.

36. **Monticola solitaria longirostris. Blyth's Blue Rock-Thrush.**

Local name : *Bulbul-i-Kuhi* or *Siah Bala*, the first local name is the same as that used for the Rock Nuthatch.

Resident in the area. A nest was obtained at Dasht-i-Gazal on April 5, 1925, and I shot several birds at Bikarz in January also at Mishun in January, February and October and on the Zuhra river in November, whilst in the British Museum there is a male and female obtained by Palmer near Bushire in March and April.

37. **Œnanthe œnanthe œnanthe. Common Wheatear.**

A single specimen of the common wheatear was obtained at Dugumbazan on April 8, 1925. Witherby got a male at Bushire on March 21.

38. **Œnanthe deserti albifrons. Desert-Wheatear.**

At Ganoweh I shot a male on February 26, 1924.

Witherby saw this wheatear at Bushire at the end of March and Palmer obtained a male there on the sixteenth of the same month.

39. **Œnanthe finchii. Barnes' Chat.**

Local name : *Oglechak.*

This chat except for a few months in the hot weather is always to be found in the area. It appears to leave at the end of June and returns again at the end of September (September 28 in 1925). They are said to breed in the hills but I did not find a nest.

40. **Œnanthe isabellina. Isabelline Wheatear.**

Local name : *Pidoom.*

This wheatear leaves us about the middle of June returning again towards the end of August, the 23rd in 1925 and the 20th in 1926. They are quite common and breed in the district and though I did not find any nest, several birds in juvenile plumage were brought in to me. Blandford considered this the commonest chat in Persia and Witherby agreed with this statement.

41. **Œnanthe xanthoprymna chrysopygia. Red-tailed Wheatear.**
Local name : *Suklak* or *Buzqalab.*
Winter visitors and the only specimens I procured were between November 9 and February 26.

42. **Œnanthe picata. Indian Pied Wheatear.**
Local name : *Karalachak.*
Witherby considered this chat rare in S. W. Persia. I obtained specimens at Mishun (1,900 ft.) in October, November, December and January, Baba Kellu (1500 ft) July 22 and Tangi-Galligau (2,100 ft.) on June 19, 1925. It is a resident.

43. **Œnanthe alboniger. Hume's Wheatear.**
Local name : *Karalachak.*
As far as I noticed this species is to be found in the area from October till the end of June and I got two specimens, a male at Tang-i-Galligau on June 19, 1925, and another male at Mishun on January 21, 1925.

44. **Saxicola torquata indica. Indian Bush Chat.**
At the Bahm-i-Shur lake I shot a single specimen on February 28, 1926.

45. **Phœnicurus ochrurus phœnicuroides. Kashmir Redstart.**
Local name : *Suklak* or *Sukhtak.*
Winter visitor, the only specimens I shot were at Mishun in January, February and November and at the Bahm-i-Shur lake in January. Witherby got a female at Bushire on March 22, 1902, and Palmer sent two males and one female to the British Museum from the same place obtained on February 25, March 5 and April 18.

46. **Phœnicurus ochrurus ochrurus. Black Redstart.**
Specimens were obtained on February 7, 1926 and January 19, 1927 at the Bahm-i-Shur lake and Mishun respectively.

47. **Phœnicurus erythronota. Eversman's Redstart..**
Local name : *Sukhta.*
A single bird was shot on January 7, 1925, at Mishun and Palmer obtained a male on the 27th of that month in 1885.

48. **Erithacus rubecula hyrcanus. Persian Robin.**
Winter visitor. A specimen was obtained at Bahm-i-Shur on February 20, 1927, and others had been seen every winter.

49. **Irania gutturalis. White-throated Robin.**
A male was shot at Mishun (1900 ft.) on April 18, 1926. Witherby records this species as common in the wooded and bush districts from 2,000 ft. upwards and even in open country, as long as there were a few bushes, it was not uncommon.

50. **Hirundo rustica rustica. Common Swallow.**
Spring visitor. Swallows arrived in the area on the following dates, 1924, February 18, 1925, February, 10, 1926 ; February 22, 1927 ; February 21. They commenced nest building almost at once—in 1925 I saw a completed nest on March 3—and the first eggs are hatched about April 12. All the young are fledged and have left the nest by May 8, and about June 6, the swallows begin to collect preparatory to their departure. By June 19, the majority of the birds have left and the remainder, with the exception of a very few which remain throughout the summer in places where there is plenty of water, have departed by July 10.

Passage migrants are seen going South about September 12, and a stray bird was observed on the plains on January 13, 1925.

Whenever possible the nests are attached to the ceilings of new or old buildings and as far as my observations go, the species was single brooded in this part of Persia.

51. **Delichon urbica. House-Martin.**
Spring visitor arriving about the end of January or beginning of February—February 7, 1926, January 23, 1927—and nesting in April. In my experience they build their nests under overhanging ledges of rock and not in buildings. Witherby says great numbers were nesting on the walls of the caravanserai of Mian Kotal (6,000 ft.) in April and he found it common but local in towns and villages. I have no date as to when they left, but consider it was in early June, a little ahead of the swallows.

52. **Ptyonoprogne obsoleta obsoleta. Pale Crag-Martin.**
Winter visitors. I obtained specimens on January 29, at Tang-i-Khor (1,700 ft.) and February 5, at Shah Taslim (2,000 ft.) but also saw examples on both earlier and later dates. Witherby saw this species at Bushire between March 21 and 25.

53. **Dryobates syriacus. Syrian Pied Woodpecker.**
This species is found in most places where there are ' Ban ' or stunted oak trees in the area but they are not common. Witherby did not meet with this woodpecker below 2,600 ft. but I got it near Mishun at about 2,000 ft.

54. **Cuculus canorus canorus. Common Cuckoo.**
Spring visitors and passage migrant. First heard on the following dates 1924, February 9 ; 1925, February 23 ; 1926, January 26 ; 1927, January 30 ; and appeared to leave at the end of April—the 19th being the latest date, one was heard and none were seen much after this date. I have no notes on the breeding of this species except that a nestling was brought in to me on April 19, 1924.

I shot a female on November 1 at Mishun and this is about the date on which this species passes through on the southward migration. At Sulabardar (2,500 ft.), I obtained a hirpatic female on March 25, 1924.

55. **Merops apiaster. European Bee-Eater.**
Summer visitor beginning to arrive towards the end of April—first noted on April 26, 1926—and leave towards the end of September or early in October. This species undoubtedly breeds in the area though no eggs or young were obtained.

56. **Merops superciliosus persicus. Blue-cheeked Bee-eater.**
Summer visitors. This Bee-eater commences to arrive in the area at the end of February or early in March and in October gradually begins to depart. I did not find any nest nor did I obtain any young.

57. **Merops orientalis beludschicus. Sind Green Bee-eater.**
These are resident in the area, nothing was seen of their nidification. Specimens were shot of December 14 and 16, 1924 ; June 13, 1926 and July 22, 1926.

58. **Upupa epops epops. Hoopoe.**
Summer visitor arriving in the end of February and beginning of March—in 1924 ; March 2, 1925 ; February 23, 1926 ; March 3, 1927 March 5 A female with four young, two or three weeks old, were brought in to me on April 18. After the middle of June this species was, as a rule, only seen singly and by October all had left, the last noted was on October 3, 1924.

59. **Alcedo atthis pallasii. Central Asian King-fisher.**
Resident in small numbers and found along streams where bushes and trees grow along the banks.

60. **Ceryl rudis rudis. Pied Kingfisher.**
Resident near the larger rivers. Specimens were obtained at Mishun (1,900 ft.) on October 26 and Bikarz on January 26, 1925 (2,000 ft.) Often seen on the Zuhra and Zeitun rivers.

61. **Halcyon smyrnensis smyrnensis. White-breasted Kingfisher.**
The commonest kingfisher in the area and found near all running streams of any size ; not, however, in large numbers

62. **Coracias garrulus semenowi. Eastern Roller.**
Summer visitor arriving in March—1924, March 13; 1925, March 12; 1927, March 27,—and leaving about July 10 or 15, but I saw one at Masjid-i-Suleiman—outside the area but in the same type of country—on August 4, 1925. In 1924 nestlings with their feathers just beginning to form were brought in to me on May 30 and on the following day I received another fully fledged. I kept several in my aviary and sent one to the London Zoo which lived for some time.

63. **Bubo bubo** sub-sp ? **Eagle-Owl.**
In May 1925 two young were brought in to me from the gypsum hills (alt. about 2,500 ft.) which I reared and subsequently sent to the London Zoo. Again in 1927 two youngsters in down were obtained on March 15 and after keeping them for some months were also sent to the London Zoo. No specimen of this bird was shot.

64. **Ketupa ceylonensis semenowi. Arabistan Brown Fish-Owl.**
A male of this owl was brought in to me on July 31, 1924, from Gach-i-Turush, circa 2,750 ft.

65. **Otus brucei. Striated Scops Owl.**
Resident. A male was obtained at Bander Rig on the coast in November 1925, a female with 4 eggs was brought in to me at Baba Kellu on April 4, 1925 and lived in my aviary for over a month and a third in juvenile plumage was caught at Mishun on May 25, 1925. In the hills this owl nests in holes in the 'Ben' trees.

66. **Asio flammeus flammeus. Short-eared Owl.**
A single example of this owl was shot at Ganoweh on the coast on January 11, 1925. Witherby saw at Bushire what he thought was an example of this owl on March 21.

67. **Athene noctua bactriana. Hutton's Owlet.**
A very common resident. Generally breeds in holes in a cliff or in a steep bank of a river. One bird reared its young in the office strong room, getting in through a ventilator hole. It laid four eggs which it successfully hatched and the young had feathers by May 16. In 1925 I sent several live specimens, which had been caught young, home to the London Zoological Gardens.

68. **Tyto alba alba. Barn-Owl.**
An example was caught alive in Mishun Castle in the spring of 1925 and sent to the London Zoological Gardens.

69. **Falco tinnunculus tinnunculus. Common Kestrel.**
A resident in the area but I was unable to find any nests though a young bird was brought in to me and kept in my aviary for some time.

70. **Aquila clanga. Spotted Eagle.**
Two specimens were caught alive at Mishun at the end of February 1927 and were sent home to the London Zoo where one lived till the end of October 1927.

71. **Circaëtus gallicus. Short-toed Eagle.**
An example of this Eagle was brought to me alive in August 1924, it had previously been kept by some local people and who said they caught it when very young in the gypsum hills near Mishun (about 2,500 ft.). In the autumn of 1924 I sent it to the London Zoological Gardens.

72. **Hieraëtus pennatus. Booted Eagle.**
Local name: *Do-baradar*.
Resident in the area and nesting on the cliffs. Two eggs were taken at Tang-i-Gogird on March 7, 1925, and one of them hatched out under a hen on March 27. Later another two young birds, ten days old, were obtained from a nest on April 18, and two more with feathers beginning to appear, were brought in to me from Gach-i-Turush on March 27, 1927.

The Persians call this eagle *Do-baradar* or two brothers from the habit of always hunting in couples, stooping alternately until the quarry is killed, when the bird which has actually killed the quarry will eat first, devouring exactly his half share of the victim, generally a chukar, and leaving the other half for its mate.

73. **Buteo rufinus rufinus. Long-legged Buzzard.**
A resident with somewhat similar habits as the last but not such a clean feeder as it will eat sick birds and mammals. Several specimens of this bird were kept in my aviary for six months or more.

74. **Circus æruginosus. Marsh Harrier.**
Frequently seen during the winter months, a specimen was obtained at the Bahm-i-Shur lake on February 22, 1925.

75. **Circus cyanus. Hen-Harrier.**
A male was obtained at Mishun on February 1, 1925. Witherby saw a few Pallid Harriers *C. macrurus* in the plains and up to 3,000 ft. and Palmer shot one at Bushire in April.

76. **Accipiter nisus nisus. European Sparrow-Hawk.**
Winter visitors, no specimens were obtained.

77. **Milvus migrans migrans. Black Kite.**
A male was obtained at Mishun on December 22, 1925.

78. **Neophron percnopterus. Egyptian Vulture.**
Resident and fairly common both in the hills and plains.

79. **Pelicanus sp ? Pelican.**
Large numbers of pelicans were seen where the Hindiyan river flows into the Persian Gulf and in fewer numbers near Hindiyan village. One or two were also observed on the Khor Khalil at Ganoweh but no specimens were shot.

80. **Phalacrocorax carbo subcormoranus. Large Cormorant.**
This species is numerous on the Persian Gulf in winter and on the Bahm-i-Shur lake where a specimen was obtained on July 25, 1926. They are also found on the larger rivers of the area and probably breed on the Islands of the Persian Gulf whilst some also may breed on the Bahm-i-Shur lake.

81. **Phalacrocorax pygmæus. The Pigmy Cormorant.**
An example was obtained on the Bahm-i-Shur lake on December 1, 1926.

82. **Anser sp ? Geese.**
Geese were seen both on the plains near Ganoweh and flying overhead at Mishun. Dawson said he saw some near the Bham-i-Shur lake. No specimens were obtained for identification.

83. **Tadorna tadorna. Shellduck.**
This duck is not a regular visitor and was only seen in the area during a particularly cold winter in 1925, at Ganoweh in January and the Bahm-i-Shur lake in February.

84. **Casarca ferruginea. Ruddy Shellduck.**
The Ruddy Shellduck arrives in the area about the middle of February and leaves again in the end of July or early in August. One was seen on the Rud-i-Shur near Bikarz on August 2, 1924. They breed both in the hills and plains and on May 17, 1924 four young, unable to fly, were captured in a pool on the Rud-i-Shur. A still younger bird was picked up on June 27 of the same year not far from where the four were found and on April 12, 1927, several ducklings unable to fly were caught on the plains north of Ganoweh. Of the original four I kept two alive in my aviary for two years when one went blind, its mate lived for another 12 to 18 months.

85. **Anas platyrhyncha platyrhyncha. Mallard.**
Not common on the Bahm-i-Shur lake but occasionaly seen in pairs in small streams in the winter months.

86. **Anas strepera. Gadwall**
A winter visitor in small numbers on the Bahm-i-Shur lake and small streams and pools in the area.

87. **Anas acuta acuta. Pintail.**
Winter visitor in very small numbers. Occasionally found on the Bahm-i-Shur lake and other smaller sheets of water in the area.

88. **Anas crecca. Common Teal.**
A winter visitor in small numbers to all suitable waters.

89. **Anas angustirostris. Marbled Duck.**
Winter visitor but not in large numbers, found both on the Bahm-i-Shur lake and other suitable pieces of water.

90. **Spatula clypeata. Shoveller.**
A pair were obtained on the Bahm-i-Shur lake on May 11, 1924, where perhaps they breed. They were never seen there during the winter.

91. **Nyroca fuligula. Tufted Duck.**
One of the commonest winter visitors but chiefly to the Bahm-i-Shur lake though I have also occasionally seen it on the rain pond at Ganoweh.

92. **Nyroca ferina.** Common Pochard.
This duck is found on the Bahm-i-Shur lake in about the same numbers as the preceding species, it also occurs on other lakes but not in such large numbers.

93. **Netta rufina. The Red-crested Pochard.**
By far the commonest duck visiting the area and found on the Bahm-i-Shur lake, the rain pond at Ganoweh and also on many of the smaller ponds in the hills but I never saw it on any of the streams in the hills.

94. **Nyroca nyroca. White-eyed Pochard.**
One of the commonest winter visitors and found chiefly on the Bahm-i-Shur lake.

95. **Erismatura elucocephala. Stiff-tailed Duck.**
Common on the Bahm-i-Shur lake where it appears to be a resident as I saw it there in the winter and obtained chicks in down on August 17, 1924. I did not see it anywhere but on the above-mentioned lake.

The following table shews the percentage of the different species of duck shot by parties on the Bahm-i-Shur lake during the winters 1925, 1926 and 1927 and checked by me :—

Red-crested Pochard	35%	Common Teal	4·4%
Common do.	13%	Gadwall	2 %
White-eyed Duck	13%	Mallard	1·3%
Tufted Duck	12·6%	Pintail	Less than 1% each.
Stiff-tailed Duck	11%	Shellduck	
Shoveller	5 6%	Brahminy	

It should be noted, however, that Brahminy Ducks were more common on other waters than on the Bahm-i-Shur lake.

96. **Phœnicopterus rubra antiquorum. Flamingo.**
Not often seen, a specimen was obtained near Ganoweh on February 6, 1925. Witherby saw two at Bushire on March 18.

97. **Ardea cinerea cinerea. Common Heron.**
An example was obtained at Shah Taslim, 2,000 ft. on January 25, 1925, and it was fairly common in the winter months, but none were noted during the summer.

98. **Demegratta asha. Reef-Heron.**
A single bird—a male—in the white phase of plumage was shot at Ganoweh on January 12, 1925.

99. **Nycticorax nycticorax. Night-Heron.**
A female of this species was caught alive at Mohammedi on the Rudhilleh river on April 22, 1925, but it did not live long in my aviary. The ovaries were very large.

100. **Ardetta minuta. Little Bittern.**
Specimens of the little bittern were obtained on May 31, 1924 and April 10, 1925 at Shah Taslim. Palmer shot a male at Bushire on March 16, and a female in April. This bird was frequently heard in the rushes bordering streams and lakes during the early summer.

101. **Ciconia ciconia. Common Stork.**
Local name : *Hajji Lak-Lak.*
A passage migrant through most of the area, though it breeds at Bebehan in the North and also at Ram Hormuz which is just outside our limits to the North.
On October 8, 1924, large flocks passed through Mishun heading south and a few days later a further flock was seen. The return migration is in February, and large numbers were seen resting on the Mishun plain on February 5, 1928.

102. **Chalamydotis undulata macqueeni. Houbara.**
This species visits the coastal plains in winter, arriving towards the end of September—September 30, 1926 at Hindiyan—or early in October and departs again about the end of March or early in April.
The houbara is hunted by the local inhabitants with falcons and provides good sport. It was said by the people of Bebehan to breed on the Lishtar plain which lies to the S. E. of that town, but I was unable to get confirmation of this.

103. **Cursorius gallicus gallicus. Cream-coloured Courser.**
Found on the coastal plains in small numbers in winter. Three specimens were obtained a male and female on January 10 and 11 at Ganoweh and a male at Bona Ismail on January 22, 1927.

104. **Capella gallinago gallinago. Common Snipe.**
Only found in small numbers, chiefly at Shah Taslim.

105. **Crocethia alba. Sanderling.**
Fairly common in winter on the shore of the Persian Gulf, I shot one at Ganoweh on January 11, 1925.

106. **Totanus totanus terrigonotæ. Central Asian Redshank.**
Two examples were obtained at Ganoweh on December 4, 1924, and January 12, 1925.

107. **Totanus nebularius. Greenshank.**
A single specimen—a male—was shot at Ganoweh on February 26, 1927.

108. **Erolia alpina alpina. Dunlin.**
A winter visitor to the coastal plain—one specimen was obtained at Ganoweh in February.

109. **Numenius arquata lineata. Curlew.**
According to my notes curlews are found near Ganoweh and along the coastal plain at all times of the year, but no doubt those seen in the summer are non-breeding birds. Occasionally the curlew is observed in the hills, several were noted near Mishun chiefly in the autumn.

110. **Pagoa leschenaulti. Large Sand-Plover.**
I have a bird shot at Ganoweh in January and four from Kharg Island in February.

111. **Eudromias morinellus. Dotterel.**
A specimen was obtained from a flock at Deh Mulleh on the Hindiyan river on January 21, 1927.

112. **Lobivanellus indicus atronuchalis. Red-wattled Lapwing.**
Resident and quite common along the streams both large and small. Two clutches of four eggs each were obtained one at Mishun on April 13, 1925, and the other at Bid-i-Zard, S. E. of Bikarz on April 14 of the same year.

113. **Vanellus vanellus. Lapwing.**
A winter visitor to both the plains and the hills. Two specimens were obtained near Bikarz on January 26, 1925, and by the Bahm-i-Shur lake on November 15, 1925.

114. **Larus argentatus cachinans. Yellow-legged Hering Gull.**
The only example of this Gull which I got was from Kharg Island on February 22, 1927, but it also occurs at Ganoweh and along the coast.

115. **Larus ridibundus ridibundus. Black-headed Gull.**
This Gull was also obtained on Kharg Island on February 22, 1927, and is likewise found along the coast.

116. **Larus genei. Slender-billed Gull.**
As in the case of the two Gulls above mentioned, this species was also brought me from Kharg Island on February 22, 1927, and is also found along the coast.

117. **Chliodonias leucopareia leucopareia. Whiskered Tern.**
Persian name : *Molaik*.
A single example—a female—was shot at Ganoweh on January 11, 1925.

118. **Chlidonias leucoptera. White-winged Black Tern.**
I shot an example of this bird while hovering over a rain pool at Kilo Kerim. on May 8, 1925.

119. **Thalasseus bergii velox. Red Sea Large Crested Tern.**
A male was shot at Ganoweh on February 24, 1927.

120. **Thalasseus sandvicensis sandvicensis. Sandwich Tern.**
Two males and a female were shot at Ganoweh on February 24, and 25, 1927

121. **Thalasseus benghalensis benghalensis. Indian Lesser Crested Tern.**
Two birds were shot at Ganoweh along with the last.

122. **Podiceps cristatus cristatus. Great Crested Grebe.**
Frequently seen on the Bahm-i-Shur lake where it may possibly be a resident. Two were obtained there on November 2, 1924 and February 1, 1925.

123. **Podiceps ruficollis iraquensis. Mesopotamian Little Grebe.**
A resident on the Bahm-i-Shur lake where I have obtained specimens in June, July, August and September and have seen many while shooting duck there in the winter.

124. **Rallus aquaticus korejewi. Water Rail.**
A female was caught at Ganoweh on December 12, 1924.

125. **Porzana porzana. Spotted Crake.**
I had an example of this crake brought in to me which had been caught at Ganoweh on June 25, 1925.

126. **Porzana pusilla pusilla. Eastern Baillon's Crake.**
A single specimen was caught at Ganoweh on October 17, 1925.

127. **Crex crex. Corncrake.**
One was procured near the Zuhra river below the Jerreh Gorge on September 27, 1925.

128. **Gallinula chloropus. Moorhen.**
A resident on the Bahm-i-Shur lake. Sharpe records one obtained by Palmer near Bushire in April.

129. **Fulica atra atra. Coot.**
A resident and very common on the Bahm-i-Shur lake and other small lakes which have water in them all the year round.

130. **Columbia livia sub. sp. Rock Dove.**

A fairly common resident in the area living in cliffs either in the hills or in stream banks on the plains.

Young birds were obtained on June 14, 1925 and May 1926.

131. **Streptopelia turtur arenicola. Persian Turtle Dove.**

A summer visitor to the area arriving April 5, 1924, April 9, 1925 and April 12, 1926, they appear to leave towards the end of September. They are found both on the plains and in the hills, nesting in the hills in Konar bushes and presumably in the gardens near villages on the plains.

Fresh eggs were brought in to me on May 4, and 27, 1924, but two young doves, about four weeks old, were brought to me on September 5, 1925. An isolated pair of doves were seen near the Zuhra river on December 16, 1924.

132. **Streptopelia risoria risoria. Ring Dove.**

A specimen was obtained at Ganoweh on August 18, 1926.

133. **Pterocles senegallus. Spotted Sandgrouse.**

Local name : *Kotoo*.

Occurs in the plains of the area in the autumn and winter only. One was obtained at Deh Mulleh on September 1, 1926.

134. **Pterocles alchata caudactus. Pintail Sandgrouse.**

Local name : *Kokar*.

These birds come to the Ganoweh section of the area in the winter and breed on the salty plains behind Ganoweh and Bander Rig. Flocks frequently fly over Mishun in the early summer, but they have not been noted to breed in the higher parts of the area though it is possible that they do so on the Lishta plain. In the autumn they appear to go towards Ahwaz. Two eggs were taken at Mohammedie on the Rudhilleh river on May 22, 1925.

135. **Ammoperdix griseogularis termeuleni. Persian Seesee Partridge.**

Local name : *Tahu* or *Tuhi*.

A common resident of the whole of the hilly part of the area and in the broken nullahs of the plains. They chiefly dwell on the rocky hillsides but are very fond of coming to a road and feeding on mule or camel droppings.

The Seesee starts breeding in April and goes on well into August. On April 12, 1924, I shot a hen with a fully-formed egg in her oviduct and on the same day obtained a clutch of 7 eggs. A clutch of 8 fresh eggs was obtained on June 9, 1924 and on July 17, 1924, a clutch of three eggs were put under a hen and hatched out on August 16. A female with a sitting of 10 eggs was obtained at Kilo Kerim on August 10, 1924, and the eggs were put under a hen but she killed all the chicks as they hatched out. On August 18, 1925, a female with a covey of about a dozen chicks, 2 to 3 weeks old, was seen near Mishun.

136. **Alectoris græca waeræ. Persian Chukar Partridge.**

Local name : *Kabk*.

Very plentiful in the higher and stonier parts of the area but have been seen very occasionally as low as 450 ft. above sea level. At this height a covey of chicks about half grown were seen on July 16, 1925. They are also met with on the smooth slopes of the gypsum hills in the area but probably prefer to live in the more rocky parts where bands of limestone outcrop. They start nesting in February and on February 23, 1926, a clutch was obtained and put under a hen and hatched out on March 23. On March 25, 1925, 29 eggs were brought in, 16 of which hatched out on April 10. On April 11, 1924, at altitude 1,400 feet, a female with a brood of young chicks was seen at Half Qil and at Bikarz on June 7, 1924, a male and female was seen with a brood of young chicks able to fly strongly. On June 29, 1924, a female with a brood of chicks as big as Seesee was put up near the top of the Kuh-i-Mishun, alt. 2,500 ft. A large number of chicks were obtained and kept in spirit.

137. **Francolinus vulgaris arabistanicus. The Persian Francolin or Black Partridge.**

Local name : *Darraj*.

A resident but there are, as a matter of fact, few places in the area where it does occur, and these are nearly all in the North or North West end. Along the banks of the Zeitun river above Deh Mulleh and up to the Kheirobad branch it is plentiful as it is on the banks of the Marun River. It is also found along the banks of smaller streams running down from Mount Khumi, more particularly in the Kumbal stream. Ilyas Khan, ' Kashquli,' brought a number and put them in the scrub at Baba Kellu, but they did not survive the construction of a road past this place.

For some reason they do not occur along the Zuhra River above the Jerreh Gorge though there are several localities which look suitable for them to live and breed in, it is possible that floods, which are frequent and severe on this river, have drowned them out.

I found the black partridge very difficult to keep in captivity and I was unable to obtain any eggs.

138. Coturnix coturnix coturnix. Common Quail.

These are nearly all passage migrants though one was shot in the scrub along the banks of the Zeitun River in December. They stay at Mishun in the spring for about a fortnight at the vernal equinox and could be heard calling in the mornings from amid the growing corn.

A NEW *CEROPEGIA* FROM THE WESTERN GHATS

BY

E. Blatter, S.J., Ph.D., F.L.S. & C. McCann, F.L.S.

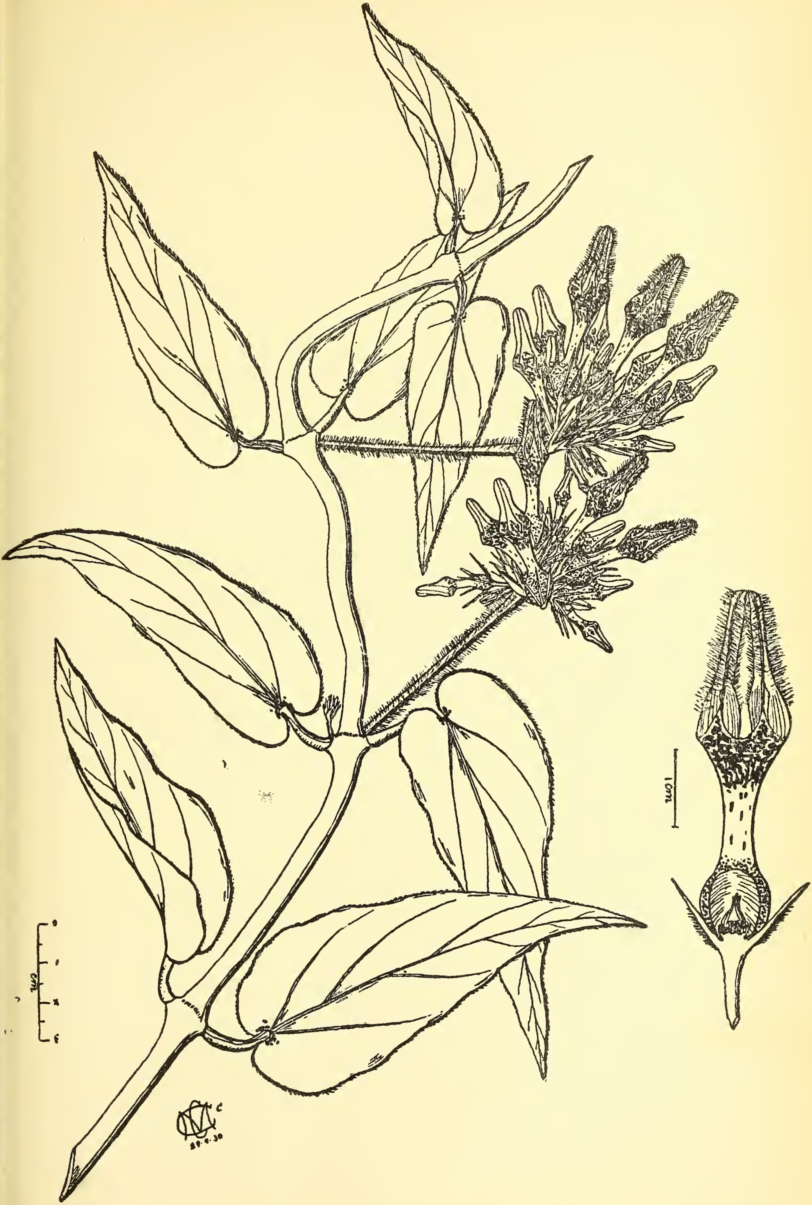
Ceropegia polyantha Blatter & McCann, *sp. nov.*

Asclepiadacea, accedit ad C. oculatam Hook., sed differt habitu suffruticoso, foliis obliquis glabris margine ciliatis, venis in facie foliorum dorsali tuberculatis, petiolis longioribus, floribus numerosis (usque ad 30), corollae segmentis in gemmis cylindricis spiralibus, sepalis duplo longioribus dorso hispidis, corollae lobis linearibus facie ventrali villosis.

Suffruticose. Root tuberous, about 8 cm. across, globose or globose-depressed, white inside, inodorous, bitter to taste. Stem up to 3 m. high, woody below, twining, often much branched, terete, shining, green, tinged with black or purple, glabrous ; internodes up to 17 cm. long, nodes thickened. Leaves membranous, glabrous excepting the ciliate margin, up to 17 by 8 cm., oblique, varying from broadly to narrowly ovate-lanceolate, acuminate, acute, cordate or subcordate at base, with undulate margin, dark green above, paler beneath, nerves depressed above and reddish to purple, prominent and purple beneath, midrib stout and fleshy beneath, all nerves beneath with pointed tubercles ; at base of leaf on upper side a number of glands (up to 12), arranged in 1 or 2 semi-circular rows, first green or yellow, finally black. Petiole stout, curved inwards, channelled above, 3·5 cm. long, tubercled on dorsal side like midrib, colour of the stem. Flowers many (up to 30) in umbellate cymes. Very often a small abortive cyme from the axil of the leaf nearest to the peduncle. Peduncle up to 6 cm. long, stiff, almost at a right angle to stem, arising from between the petioles but always closer to one petiole, hispid with spreading white hairs, thickened upwards, dark purple. Pedicel 1·5 cm. long, sparingly hispid. Bracts subulate or linear-lanceolate-acuminate, green or purple, glabrous. Calyx divided to the base ; sepals 1·5 cm. long, subulate sparingly hispid on back, purple. Corolla 5 cm. long, straight. Tube much inflated below, almost globose, about 9 mm. diam., pale green, finely mottled with purple, upper part of tube below the throat perfectly cylindrical, pale green with sometimes a few purple dots ; then tube widened like a funnel, pale green, with larger purple markings. Lobes in bud forming a slightly twisted cylinder, when open 2·2 cm. long, erect, linear, somewhat broader at base, with the margins reflexed, connate at tip, dark green in the upper ¾, paler yellow green in the lower part, villous on ventral side, glabrous on dorsal, ciliate on margin. Inflated base of tube black with long villous hairs inside, divided from the tube by a yellowish green line, above this line deep brown purple, almost black, passing into the yellow green striate throat where the external mottling is showing through. Outer corona cup-shaped, 5-lobed, each lobe bifid, teeth acute or obtuse, lobes purplish above the middle, hairy inside and along margins and a few scattered hairs outside, below the middle yellow, hairy inside, glabrous outside. Inner corona of 5 linear, obtuse lobes, purple in the upper part, yellowish in the lower, glabrous, straight, 3 mm. long, apex minutely papillose ; stigma pale green. Pollinia yellow. Fruit not seen.

Loc. : Lingmala hills near Mahableshwar, generally on *Randia dumetorum* Lam. (McCann & Fernandez 3470 A, B, C, D ! type, 3441 !, 3442 !, 3471–3478 ! cotypes) ; Khandala, on top of 'Sausages' (Blatter ! Herb. St. S. X. C.).

Fl. : September 30, 1918 (Khandala), September 27, 1930 (Lingmala).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Ceropegia polyantha Blatter and McCann, sp. nov.

NOTES ON SOME RATS DAMAGING CROPS IN SOUTH INDIA.

BY

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It is universally recognized that there are few animal pests that cause, by their depredations, greater loss to man than those belonging to the group popularly known as Rats. On account of their numerical strength, wide distribution, their great fecundity and adaptability to varying conditions and omnivorous feeding habits, these have attained unenviable notoriety all over the world. But it is only recently, comparatively speaking, that the highly important rolê played by them in the destruction of crops has come into prominence. The destruction caused to crops by these is undoubtedly frightful, the loss sometimes amounting to very nearly fifty per cent of the gross outturn.

Incredible as it may seem, it is nevertheless a fact that Economic Zoologists, particularly in India, have paid deplorably little attention to this group of rodents; consequently there is practically very little on record regarding the exact species concerned in the damage, their habits and the method of their control, except the very brief and passing reference made by Fletcher in his excellent book on *Some South Indian Insects.* Therefore, the present paper, so far as the writer is aware, is perhaps one of the first if not the first venture in this direction in South India.

Although a variety of important crops such as Paddy, Ragi and other grain crops, Sugarcane, Cotton, Coconuts, Tea, etc., are subject to the ravages of these pests, it is a pity that our knowledge of these is very scanty and limited and it is no wonder that any control measures based on such knowledge as we possess of the lifehistory and habits of field rats have been in most cases unavailing. It is believed, therefore, that any information regarding the biology of these animals, mode of life, occurrence, breeding, habitations, etc., will be of great importance in tackling this serious problem. With this view the writer has been devoting some time and thought for the last few years, amidst his other duties, to the study of this particular group. To this end some of the most important species, e.g. the Southern Mole-rat *Gunomys,* were kept under observation in cages at the Insectary and elsewhere. The habitations of many have been examined in the fields and some repressive measures also have been carried out though to a limited extent.

In any branch of study the correct identification of the species should form a necessary preliminary and should always precede other aspects of study. The proper identification of this class of rodents has been a matter of some difficulty as a result of the vast strides of progress in our knowledge in this line since the publication by Dr. Blanford of his classical work on Mammalia in the *Fauna of British India* series. Since 1891 when this standard work on Mammalia was published so many new forms have been discovered, and so many changes in nomenclature have been found necessary that identifications based mainly on this work will necessarily be to a certain extent out of date. The progress in this direction is mainly due to the Mammal Survey conducted by the Bombay Natural History Society the results of which are published in the various volumes of the *Journal*. Therefore with the help of the latter the nomenclature of each species has been carefully investigated and the writer has thought it wise to include along with the distinguishing characters of each species, the present day nomenclature, chief synonyms, the popular and vernacular names and a few facts about their distribution. Vernacular names are given wherever known but these will be of little value as the ryots do not discriminate between the various kinds of rats but often apply one common name for all.

The idea of the paper is primarily to introduce the reader to such of the species of rats as have come within the personal cognizance of the author in South India, as also to indicate the gaps in our knowledge and the lines on which further investigations are needed. Some explanatory notes regarding the details of habits of some species with a few remarks about the nature and extent of damage to various crops and their status, with a brief reference to the localities wherefrom they have been collected are added under each species. A few remarks regarding their control partly based on the writer's experience have also been included so as to impart a sort of completeness to the subject dealt with. In presenting these few notes nobody is more conscious than the writer that the work is necessarily very defective and incomplete in regard to every aspect of study, and the only justification for the preparation of this paper is that it may at least serve to invite the attention of economic biologists to the importance of this group of animals.

The material on which the paper is based consists of specimens collected by various persons from time to time and received by the Government Entomologist, Coimbatore, as well as those collected by the writer as opportunities offered. Hence the writer is under great obligations to the Government Entomologist for the opportunities afforded, especially at the beginning of the study, and to those members of his staff who have helped with specimens. The writer is also indebted to the Bombay Natural History Society for having confirmed and corrected his provisional determinations of the different species of rats.

In the matter of arrangement of the different species the writer has gone a little out of the way because the main consideration has been the order or degree of destructiveness of the species concerned. So far as the writer's observation goes the premier place according to this criterion will have to be assigned to the Southern Mole-Rat (*Gunomys*.) Then next in order come the Soft-furred Field Rat, the South Indian Gerbil, etc., which are also responsible for a good deal of damage to crops.

FAMILY : MURIDÆ.

Sub-family : GERBILLINÆ.

Genus : TATERA, Lat.

Tatera, Lataste 1882. Wroughton. *J.B.N.H.S.,* xxv. p. 40, 1917 and xxvi, p. 779, 1919.

The group of animals represented by the name *Gerbilus indicus* in Blanford's Mammalia No. 264 was separated as the sub-genus under the name *Tatera* in 1882 and later on Indian forms were named *Tatera* as a full genus in 1902. The tail of these forms is dark above and below and pale along the sides. *Tatera* has the sole and foot entirely naked whereas *Gerbilus* has sole and foot hairy.

(1) **Tatera cuvieri** Waterhouse. **The South Indian Gerbil.**

1838. *Gerbilus cuvieri* Waterhouse, *P.Z.S.,* p. 56.

1891. *Gerbilus indicus* Blanford, Mammalia, No. 264 (Part).

1917. *Tatera cuvieri* Waterhouse Wroughton, *J.B.N.H.S.,* xxv, p. 44.

Vernacular name.—*Velleli* (white rat).

These buffy coloured rats have their feet longer and their tails are also nearly two inches longer than typical *indica* and this is the distinguishing character of *cuvieri.*

Head and body 5·2 in—7·2 in about 6·6 in.

Tail more than 7·9 in (*indica* less than 7·5 in).

Hind foot 1·4 in—1·9 in about 1·7 in.

This is not an uncommon species. It is not so universally distributed as *Gunomys.* This species is destructive to paddy, especially stored paddy, outside buildings in Aduturai (Tanjore). They also destroy coconut seedlings in some parts of Malabar by burrowing underneath and feeding on the tender portion of the shoot inside. Our knowledge about the habits of this animal is unsatisfactory. These have more or less a straight run and the depth might vary from ½ to 2 feet. The burrows may have more than one entrance. These burrows are often made in a day and are not so extensive as those of *Gunomys.* The rats perhaps have their permanent residence in adjoining bushes, prickly-pear and such suitable places. These are also reported to store a good lot of grain in their burrows.

Sub-family : MURINÆ.

Genus : GUNOMYS, Th.

Gunomys, Thomas. *Ann. & Mag. Nat. Hist.,* xx, p. 202, 1907 and *J.B.N.H.S.,* xviii, p. 465, 1908.

From the genus *Mus* (Rats) the bandicoots were first separated by Gray in 1842 under the generic name *Nesokia* (*Nesocia* of Blanford). Thomas seeing three well-marked groups in this genus divided *Nesokia* into three genera (*Ann. Mag. Nat. Hist.,* xx, p. 202, 1907). Blanford uses *Nesocia* (as he spelt it)—*Nesokia* for all the groups. But Thomas restricted the name to include only the short tailed mole-rat of Northern India and at the same time revived the genus *Bandicota* and erected the genus *Gunomys* to represent the Southern or long-tailed mole-rats. The chief characters of *Gunomys* are the small size, and length of the tail being more than two-thirds of head and body, and, mammae being irregular, 14-18 in number. Whereas *Nesokia* has the tail very short less than two-thirds of head and body; mammae 2-2 = 8; *Bandicota*—Size large, tail almost as long as head and body; mammae 3-3 = 12.

(2) **Gunomys kok** Gray. **The Southern Mole-rat.**

1837. *Mus kok* Gray. Charl. *Mag. N.H.I.*, p. 585.
1891. *Nesocia bengalensis* Blanford, Mammalia, No. 295. (Part).
1908. *Gunomys kok* Wroughton, *J.B.N.H.S.*, xviii, p. 747.

Vernacular names.—*Kurumbai yeli; Erumira yeli* (i.e. noise like coughing of man) also called Paddy field rat.

Distinguishing Characters.—Length of upper molar series 8 mm. Head and body, 6-9″, Tail 5-7″. Fur, fine soft. General colour dark greyish brown. Belly, greyish white. Tail, practically bare.

This is perhaps the most formidable of our crop destroyers. It is a very abundant species throughout the Madras Presidency extending even to the hills. They are very destructive to paddy everywhere. They are known to damage paddy in such widely different places as Coimbatore, Samalkota, Tanjore (Aduturai) and many other places. They also destroy Ragi crops in Coimbatore to a very large extent. Many other crops, such as roots of Tea bushes in Anamalais Estate, have also received their attentions. They are concerned in the destruction of coconut seedlings in some parts of Malabar by burrowing underneath the soil and feeding on the tender portion of the seedlings. They also destroy Tapioca roots in Malabar and sometimes feed on the underground portions of plantains and Colocasia in the same district. In the Southern taluks of Malabar it has been noted to be a bad pest of a variety of pumpkin—*Cucurbita maxima*—whose large fruits, resting on the ground, are eaten into from under the soil leaving only the hard outer rind intact and to all appearance undamaged. Mole-Rats are very destructive to Lucerne crops in the Central Farm, Coimbatore, by eating away the soft succulent portion of the roots. In these plots regular rows of these plants can be seen dried up. If pulled out they are found to be devoid of the root portion which has been devoured by rats.

It may, therefore, be assumed that this is the most destructive species in South India, attacking as it does a variety of crops, being plentiful in and near about cultivated fields. Its favourite resorts are paddy fields. In Coimbatore they are equally abundant in Ragi fields. Several of their habitations in both paddy and ragi fields have been dug out and several specimens collected and examined and the following account of their habits and habitat is mainly based on such observations.

In paddy fields the burrows are chiefly confined to the bunds when the crop is in ears. But during the off season burrows are not found in all bunds but are restricted to those bunds situated by the side of water channels; probably the species requires to be near water being a good diver and probably a great drinker. The runs are long, extensive and somewhat complicated. They may extend to 20 or 30 feet or even more. They have sometimes four or five openings or exits. The runs seldom go beyond a depth of 2 feet below ground and are rarely more than 3 or 4 inches in diameter. The presence of a burrow is always indicated by the heap of fresh earth thrown by the side of the bund. Generally the main entrance is kept obscured from view by this heap of earth. There are sometimes three or four branchings (even half a dozen) some of which may end in blind ways. It is because of these exits that the rat often escapes from some unexpected side of the bund when digging is going on at the other side several feet away. Generally only one rat, rarely two, is found to inhabit one burrow. In the breeding season it is easy to find a mother with a number of young ones rising up to ten. The nest in the breeding chamber consists of grasses and other leaves. Inside such runs plenty of grain (paddy earheads) are hoarded up in the harvesting season. At other times small accumulations of grasses and roots can be seen, showing that they can subsist on these for a time. Sometimes remains of crabs such as the carapace, limbs, etc., have been recovered, along with grasses, from the runs.

In the Ragi fields the conditions are slightly different and the burrows are seldom found on bunds but are practically within the fields themselves. The branching runs in Ragi fields are confined within a radius of 4 or 5 feet and lead into a kind of central chamber. The destruction done to the crop is considerable. From one of the burrows, extending nearly to a depth of 2 feet with three side exits, dug out recently, which had only one female occupant, a quantity of Ragi earheads which would give nearly three-quarters of a Madras measure of grain, was actually recovered and there are numerous such habitations in the field.

These rats are very active and wonderfully agile and are gifted with considerable speed as is evident from their alertness in escaping. They also dive splendidly in water in fields, so much so that four men could not recapture one that escaped in water. They are very fierce and utter a peculiar grunting sound when in fear or anger. Mole-Rats are to a certain extent pugnacious among themselves as is shown by the fact that when two adult specimens were kept in captivity in a cage they carried on some kind of fight and the male lost almost the whole of its tail which was bitten off by the female. After three days the same poor creature was severely injured by its companion and actually killed. A mother and nine young ones, captured from paddy fields, were kept in cages under observation for nearly eight or nine months. These were cónfined in woden cages the sides of which were much gnawed into and such portions had to be covered with tin plates. In confinement the rat is very fierce and often jumps and dashes against the glass sides and wire gauze in attempting to bite anything that comes near. These were mainly fed on Cholam earheads, cotton seeds from bolls, paddy, pomegranate fruits, Ragi earheads, prickly-pear fruits, wheat, gingelly seeds, etc., but they will eat anything that is supplied, with great avidity. The young ones in three months became adults and one of these produced nine young ones at a birth. The mother made a nest with cotton lint thrown into the cage within which the young ones were wrapped. When this cotton padding was disturbed the mother was observed to carefully set it right by rearranging them in cotton.

They were born naked and blind and did not open their eyes until after some days, nearly one month, when they were covered with fur and fairly grown. They were completely helpless till about that time. One peculiar case of cannibalism was observed in this instance, within fifteen days of producing young ones, seven out of nine were eaten up by the mother, one after another.

The chief enemy of these rats is probably man. Mole-Rats are eagerly searched for by some communities in South India and captured for food. In Tanjore the Pariahs are said to dig up the bunds and feed on the flesh of these animals which is said to be good eating.

The control of this rat is rather difficult. Fumigation will not be effective as the runs are extensive and poison baiting is no use as the rats may not eat this when there is plenty of other food available. The best thing under the circumstances especially in paddy fields will be to employ professional rat catchers to dig up the bunds in the off season and carry on a regular campaign against them.

Genus : MILLARDIA, Th.

Millardia Thomas, *J.B.N.H.S.*, xx, p. 998, 1911.

The Genus *Millardia* was erected by Thomas in 1911 for the 'Meltad' rats and he separated them from *Epimys* as they differed in an essential character, viz. the suppression total or partial of the posterior sole pads.

(3) **Millardia meltada** Gray. **The Soft-furred Field Rat.**

1837. *Golunda meltada* Gray. Charl. *Mag. N.H.I.*, p. 568.
1891. *Mus meltada* Blanford, Mammalia, No. 290.
1911. *Millardia meltada* Thomas, *J.B.N.H.S.*, xx, p. 998.

Vernacular name.—*Pilleli* (Grass Rat).

This is a smaller rat than *Gunomys*. It is dark brownish grey above and pale grey below. The fur is very soft. Head and body about 5 inches, tail 4 inches.

This species does some damage to paddy though it comes only second in rank to *Gunomys*. Specimens of these have been obtained from Aduturai where they are injurious to paddy. The burrows are fewer and shallower and are found in bunds of paddy fields. These will not get into water and have no peculiar habit of diving.

At Coimbatore these rats are confined to cotton fields. They do considerable injury to cotton and sometimes are very numerous. They seem to be gregarious in that more than one (sometimes three or four) may be found in a single burrow where accumulations of cotton kapas, sometimes to the extent of one or two pounds, may be seen. They do not so much inhabit burrows as the cracks of sun baked earth in the fields. They probably have their permanent residence within the adjoining prickly-pear bushes, periodically invading cotton fields nearby.

Genus : Leggada, Gray.

Leggada Gray. Thomas, *J.B.N.H.S.*, xxvi, p. 418, 1919.

The genus *Leggada* was first separated from *Mus* by Gray in 1837 because of the presence of an additional lunate lobe on the anterior face of the first molar. But this character was later on found to be not constant or imperfectly developed. Mr. Thomas, therefore, considered that the name *Leggada* will have to be sunk as a synonym of the genus *Mus*. But he (Thomas) again revived and re-established the name *Leggada* for Field Mice or Jungle Mice and restricted the name *Mus* to House Mice proper the chief difference between the two being longer or shorter muzzle. (*J.B.N.H.S.*, xxvi, p. 418, 1919.)

(4) **Leggada booduga** Gray. **The Southern Field Mouse.**

1837. *Leggada booduga* Gray. Charl. *Mag. N.H.I.*, p. 586.

1839. *Mus lepidus*. Elliot, *Mad. Mag. L.&S.X.*, p. 216.

1891. *Mus booduga* Blanford, Mammalia, No. 287.

1919. *Leggada booduga* Gray. Thomas, *J.B.N.H.S.*, xxvi, pp. 419 and 960.

Vernacular name.—*Chundeli* (Small Rat).

This is a pretty little mouse of varying shades of colour, generally of a greyish white colour. This is easily marked off unmistakably from other rat pests mentioned because of its small size, which varies from 2½ to 3 inches; with a tail about the same length.

This species is somewhat rare. They have been collected from Ragi fields and cotton fields of Coimbatore and they do slight damage to the crops. In the Ragi fields they are found in small burrows in bunds and not in the field itself. The burrows are usually small and simple and not extensive or complicated. They may also be found in heaps of stones near the field. It is said that they display to a great degree the phenomenon of cannibalism inasmuch as many are killed and eaten, if a large number is kept confined in the same cage, even when plenty of food is available.

Genus : Rattus, Linn.

Rattus rattus Linnæus.

The separation of rats under the name *Epimys* from the mice (*Mus*) was proposed by Trouessart in 1881. (*Bull. Soc. Sci. d. Angers*). Hollister showed that the oldest name for the genus is *Rattus* and must be used in place of *Epimys*. The Common Indian House rat *Epimys rufescens* or *Epimys rufescens* 'var. with white under parts' of the Mammal Survey reports and *Mus rattus* of Blanford are indistinguishable from *Rattus rattus* Linnæus, as pointed out by Hollister and confirmed by Hinton, *J.B.N.H.S.*, xxvi, p. 59, 1918. So Blanford's genus *Mus* includes both *Rattus* (rats) and *Mus* (mice) and his *Mus rattus* is *Rattus rattus*. This species *Rattus rattus* shows a definite variation so that many races have been recognized as noted by Hinton (*J.B.N.H.S.*, xxvi, p. 63).

(5) **Rattus rattus wroughtoni,** Hinton. **The Common Indian Rat.**

1891. *Mus rattus* Blanford, Mammalia, No. 272. (part).
1912. *Epimys rufescens,* variety with white under parts Wroughton. *J.B.N.H.S.,* xxi, p. 1189.
1919. *Rattus rattus wroughtoni,* Hinton, *J.B.N.H.S.,* xxvi. p. 384.

Vernacular names.—*Veetteli* (House Rat); *Yeli* (Rat).

This sub-species *R.r. wroughtoni* is recognized by its pure white belly from the other sub-species *R.r. rufescens* which has a dark belly. The general dorsal colour is reddish or yellowish brown. The feet are light whitish or yellowish. This rat is mainly destructive to tender coconuts. Its damage has been noted from Coimbatore and its suburbs, Malabar, Cochin, etc. Perhaps this damage occurs everywhere in the south, its attentions being mainly confined to tender coconuts which are damaged in large numbers. They bite holes through the husk or fibrous portions and through the tender shell of unripe nuts in order to drink the sweet liquid contained within and these spoilt nuts drop down in large numbers. They live and breed inside nests specially constructed in the crown of palms and rarely descend. The nests are made of fibrous strands that serve the purpose of attachment of the leaf stalk to the stem and leaflets. These are wound round after being bitten to the proper size leaving a cylindrical space in the middle.

Some protection may be given to these trees by providing zinc hoods in case the trees are not so close together as to have their leaves touching one another. But in the case of large topes having thousands of trees in contiguous rows the only practicable remedy is to apply poison baits.

(6) **Rattus rattus rufescens** Gray. **The Common House-Rat.**

1837. *Mus rufescens* Gray, *Ann.Mag. N.H.I.,* p. 577.
1891. *Mus rattus* Blanford, Mammalia, No. 272.
1912. *Epimys rufescens* Wroughton, *J.B.H.N.S.,* xxi, p. 405. 405.
1919. *Rattus rattus rufescens,* Hinton, *J.B.N.H.S.,* xxvi, p. 403.

Vernacular names.—*Veetteli* (House-Rat); *Yeli* (Rat).

This is the ordinary house rat and this species is dark bellied (as distinguished from previous sub-species which is white bellied). It is brownish grey in colour (rufous). There is no sharp line of demarcation along flanks.

This rat is omnivorous feeding on all kinds of vegetable and animal food available. Its habits are well known. It lives in roofs of houses and burrows in the ground and store rooms doing considerable damage to stored paddy, cotton seeds and various other stored products. Its havoc is great in warehouses and storehouses as silks, leather goods, carpets and groceries are all subject to its attacks. Besides causing the destruction of property they are also a source of menace to our health being the common carrier of the Plague flea. The justification for the inclusion of this species among crop destroyers is due to the fact that they are very destructive to paddy stored outside soon after harvest—Poison baiting is the only practical remedy.

FAMILY : GLIRIDAE.

(7) **Platacanthomys lasiurus** Blyth. **The Malabar Spiny Mouse.**

1891. *Platacanthomys lasiurus* Blanford, Mammalia, No. 263.

1913. *Platacanthomys lasiurus* Ryley, *J.B.N.H.S.*, xxii, p. 507.

This is the only one of the species mentioned in this paper which has not been seen by the writer. They are reported to live in hollowed out cavities in trees. They are said to destroy pepper, jack-fruit, and cardamoms in hill tracts in Travancore, Anamalais, etc. They are also reported to hoard up grain and roots like Gunomys and Tatera. They are said occasionally to get into toddy pots. They are said to be easily smoked out of the hollow dead branches which form their chief abode.

CONTROL MEASURES.

It has been seen that enormous damage is caused by different species of rats to a variety of crops and the resultant losses in some cases may run to a high percentage. Therefore the consideration of the question of the preventive and control measures of rat damage is of utmost importance. Various methods such as hunting, trapping, fumigation and poison-baiting have been recommended for trial among which the last two—poison-baiting and fumigation—have been given a fair trial in South India with varying results. In any successful application of remedial measures a preliminary knowledge of the habits and mode of life of the pest concerned cannot be over-emphasized. The methods attempted in this part of the Presidency have been carried out on the lines suggested in *Pusa Bulletin* No. 135 of 1922 and these may be briefly summarized as follows.

Poisoning.—This is the quickest means of destroying rats and has some decided advantages in some cases over others but a proper exercise of caution is required in carrying it out in order to ward off accidents. The principal poisons used in preparing the baits are strychnine, plaster of Paris, barium carbonate, arsenic and Paris green, potassium cyanide and phosphorus.

The preparation of these baits is indicated thus :—

1. *Strychnine.*—About one oz. of strychnine sulphate is dissolved in $1\frac{1}{2}$ oz. of warm water and this is mixed with a thick syrup of jaggery, made with two seers of jaggery and half a seer of water. The mixture is heated and is sifted gradually over fifteen seers of grain. After twenty-four hours one oz. of the bait untouched by hand, is put into every rat hole, as the rats are said to have a ready perception of the smell of the human hand, any taint of which causes them to leave the bait severely alone.

2. *Plaster of Paris* (1 lb.) is substituted for strychnine.

3. *Barium carbonate* may be substituted for plaster of Paris.

Another poison bait easily prepared is by mixing Paris green with cooked rice. A bait that is commonly tried in Malabar against *Rattus rattus wroughtoni* with great success is prepared in a simple manner. Rice is boiled with onions with a little coconut oil for flavour. To this is added a little arsenic poison. Small balls of these, of course untouched by hand, are placed on crowns of coconut palms.

Fumigation.—This method to destroy rats in their burrows has been tried in several instances with good results. The success of this measure will largely depend on the nature of the burrow and the thoroughness with which the exit holes are traced and closed. It may be ineffective or useless where the burrows are very complicated or labyrinthine. Carbon bisulphide, calcium cyanide dust, sulphur arsenic fumes have all been used to asphyxiate the animals in their habitations. Before fumigating however all entrances to rat runs should be carefully spotted out and closed with earth. In applying carbon bisulphide the method adopted is to saturate some cotton wool or other absorbent material such as a piece of sponge or handful of rags with the liquid and introduce the same into the rat burrows and finally close the opening with earth to prevent the gas escaping. Calcium cyanide may be used in a cyano-gas dusting machine by which the dust is pumped into the burrow. Sulphur arsenic fumes may be introduced by means of an ant exterminator.

Rat viruses.—In America several micro organisms or bacteria found originally in deceased rats have been exploited for destroying rats. Such rat viruses are reported to be largely advertised in that country. The results of trials with these have also been reported to be unsatisfactory. Even if they were successful the cost of the cultures would be prohibitive for general use.

Organized rat-hunts will certainly confer great benefit. Skilled and trained hands can effectively control rats by trapping. But in this more than in any other the need for organization and co-operation cannot be stressed too much so as to make the campaign effective and fruitful.

The encouragement of all natural enemies of rats is certainly one of the means of checking their increase.

It may be noted that in some cases the problem of their control may have to be tackled by a combination of some of these methods so as to yield beneficial results.

CONCLUSION.

In presenting this note, especially the latter portion regarding control, the writer had other objects in mind than merely giving a narrative of several measures tried but for want of greater opportunities for actually testing these in the field the portion dealing with this aspect is necessarily unsatisfactory. It is also felt that there is much room for further studies of the habits and habitations of these animals on which the entire question of control mainly hinges. In spite of all these defects the writer ventures to hope that this paper will have achieved more than what it set out to do if it, in the least manner, leads to greater familiarity with or increased interest in these unattractive but very important animal pests.

THE NESTING HABITS OF THE BAYA (*PLOCEUS PHILIPPINUS*).

A New Interpretation of their Domestic Relations.

BY

Salim A. Ali, M.B.O.U.

(*With 7 plates and 11 figures in the text.*)

Having had exceptional and uninterrupted opportunities for studying the Baya this nesting season (1930), I have endeavoured to tackle some of the much-debated points in connection with the breeding habits of this interesting little bird. To my mind, my observations have not only dispelled all doubt as regards the origin and significance of the so-called 'Cocks' Nests', but have also thrown some light on the hitherto unsuspected and remarkable relationship between the sexes.

Bayas are common in the Alibag Taluka of the Kolaba District, about fifteen miles from Bombay down the coast. Out of the breeding season they go about in flocks often numbering upwards of a hundred birds. Small parties are commonly met with on Coral trees (*Erythrina indica*) immediately after the blooms have withered, and, though I have not examined the stomach contents of birds feeding on these trees, as far as could be ascertained from careful observation through field-glasses, they appeared to feed on the tender newly formed pods.

By the middle of May, some of the males had already acquired full breeding plumage, while a great many were in a transitional stage. At this time small flocks were constantly seen frequenting the interior of dense bushes during the heat of the day, indulging in choruses of *chit-chit-chit, chee-ee-ee,* so familiar while the birds are engaged in nest-building.

The earliest date on which a company of cocks—all in full breeding dress—were noted busy building was May 22. On July 30, I came upon a small flock comprising about five cocks in full breeding plumage and an equal number of what appeared to be females, feeding on an out-of-the-way cart track. I got five specimens in one shot; dissection proved that these were all males. Two were in breeding plumage with testes about the size of small peas. The other three had their colouration somewhat richer and brighter than females, and besides, had a slightly golden tinge on the forehead: Their organs were undeveloped and no bigger than pin-heads. These birds were probably in their first year.

On August 19, by which date nesting appeared to be in full swing everywhere, I discovered a colony (No. 1) building on a Babool tree (*Acacia* sp.) standing isolated in the centre of a tank formed in a depression in the midst of paddy cultivation. This appeared a suitable spot for observations as it was close enough to my bungalow to allow frequent access, and yet sufficiently out of the way for village lads not to disturb the birds or tamper with my arrangements. I had a step-ladder rigged up, about eight feet high with a small platform at the top, just large enough to accommodate one person sitting on a stool. Around the platform were fixed upright palm leaves so as to form a kind of 'hide'. This step-ladder-hide was placed in the tank in knee-deep water opposite the colony, at a distance of ten to fifteen feet from the nests, and ever since and up to the time when all the young had left the nests I spent from half to three hours at a time in it almost every second or third day. The platform brought me more or less on a level with the nests, and I was enabled to observe and photograph the birds at work at close range and under comfortable and perfectly normal conditions. On the first appearance of the 'hide' the birds seemed rather alarmed, but as it was left standing there, day in and day out, they soon became used to it and grew indifferent to its presence even when occupied.

I give below the results of my observations which extended over several months. These are based on notes in my field diary relating not only to the colony which I have designated No. 1, but also to numerous others which were under regular observation throughout the period with the aid of powerful field-glasses. My notes, relative extracts from which I append, were all made either on the spot or soon after my return from the vigil. Only in a few instances I have had to elaborate them somewhat, so as to be intelligible to the reader.

Site.—It is difficult to determine what are the exact factors that govern the selection of the site for a nesting colony. When there are a number of trees standing close to one another in almost identical situations, and apparently—from human considerations—all equally suitable, what makes the birds single out just one particular individual, and then perhaps there may not be another colony within a radius of half a mile or more?

The trees most favoured in these parts (Alibag Taluka) are Babool (*Acacia* sp.), Ber (*Zizyphus* sp.), Palmyra Palm (*Borassus flabellifer*), Tamarind (*Tamarindus indica*), and Coral (*Erythrina indica*). The first three are certainly the most patronized, while in my experience, *Erythrina* is resorted to exclusively by young cocks building late in the season. Besides these, I have only once seen a single nest on a Casuarina (*C. equestifolia*). The same tree may be used for two or several successive seasons, but as regards the same *nest* being used more than once, I have no experience. Hume mentions[1] that 'the same nests are at times used during the second season.' From what he writes, however, it would in any case appear that this is only in exceptional or very rare cases. In the only instance that came under my notice where an old site was being used—Colony No. 1—all the old nests were pulled down by the birds either before commencing or simultaneously with the building of new ones, although some of the old nests appeared in fairly good condition. One thing is certain that the birds invariably

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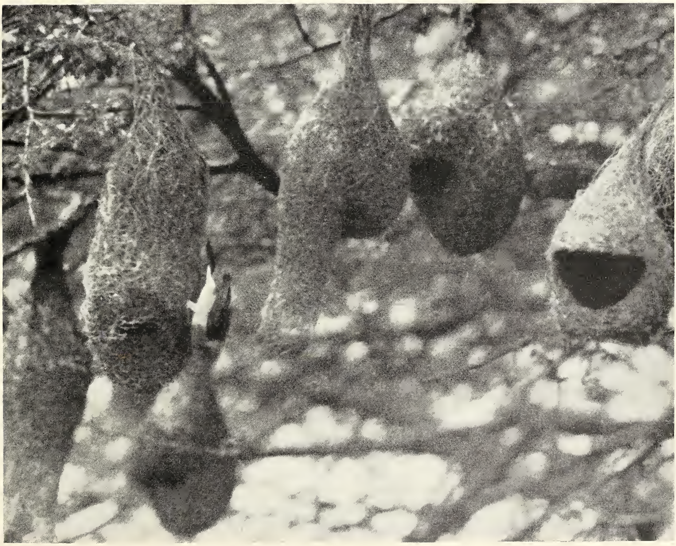
[1] '*Nests and Eggs of Indian Birds*', Vol. ii, p. 117.

1. My Observation 'Hide' in position at Colony No. 1.



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2. A 'Close up' of a portion of above Colony.

select the eastern side of the tree to build upon, which is protected from the South-West Monsoon. I have found this to hold good in the case of every colony that has come under my observation so far, either in this or previous seasons, except one which consisted of one completed and two half-built nests facing in the opposite direction. It may be mentioned, however, that these latter were built unusually late in the season—about the end of September—when the severest part of the Monsoon was over.

The nests are often suspended from branches overhanging water. It is difficult to imagine what advantage the bird derives from this habit. Where the selected tree is isolated and stands like an island in water, one can understand the nests being more or less protected against rats and other terrestrial animals. But before being able to say anything on this point, it is first and foremost necessary to ascertain who are the natural enemies of the Baya. On this matter, I have no direct evidence though my notes (September 25) show that in Colony No. 2 all the nests had been torn open near the egg-chamber and deserted. The Palmyra palm on which they hung stood on a bund between two paddy fields, and the destruction in this case may possibly be the work of a rat or some other terrestrial animal. On the other hand, I have noted (October 3) the agitated behaviour of the members of Control Colony (for a description of this, see Appendix, 'September 26'), when a Crow Pheasant (*Centropus sinensis*) appeared in the proximity of the tree, while they remained indifferent to the presence of a pair of Koels (*Eudynamis scolopaceus*), who are also destructive to the eggs of small birds, but only in open nests as far as I am aware. I have seen a Crow Pheasant tear open a nest of a Sunbird (*Leptocoma zeylonica*) and suck the eggs, and it may be permissible to accept the perturbation of the Bayas in this instance as circumstantial evidence of its doing the same with Baya nests, given the opportunity. On another occasion (October 13) I have noted a Shikra (*Astur badius*) making an unsuccessful stoop on Colony No. 1. If then, the chief enemies of the Baya are winged, what is the advantage of suspending the nests over water?

Now as regards mammals. The suggestion by Mr. Horne[1] that the newly-built nests he observed on the ground under the tree was the work of squirrels for use of the material in their own nests, is I think, untenable. In the country where I have so far had opportunities of observing the Baya, I have never come across a squirrel's nest built of the same material as a Baya's. Moreover, I continually found nests in all stages of construction floating under the tree at Colony No. 1 which stood in knee-deep water, which was decidedly not the work of any but the cocks themselves, as has also been observed by Spennemann with *Ploceus manyar* in Semarang.[2] I watched several from time to time, snipping off the suspensions deliberately, fluttering their wings and joining in the choruses as they did so. The work of undoing was treated in the nature of serious occupation on a par with the building. The reason for this destruction was impossible to guess. There may as has been suggested, be some defect in the construction with which the builder or the inspecting female was dissatisfied, but on the other hand I have found a completed nest lying on the water which contained two fresh eggs (September 18). This latter I suspect to be the work of some disgruntled rival.

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[1] '*Nests and Eggs*', Vol. ii, p. 118.

[2] Aug. Spennemann, "Iets over Ploceus manjar" De Tropische Natuur 1926, pp. 186—189.

To continue with Mr. Horne's suggestion. To my mind the only other motive for the squirrel in snipping off the nests could be to get at the eggs, and Mr. Horne himself mentions that 'some of them had unbroken eggs in them.' Thus apparently, his squirrels derived no profit from destroying the nests!

We have, therefore, still to discover the natural enemies of the Baya in order to understand the significance, if any existing, of the habit so commonly observed, of building over water.

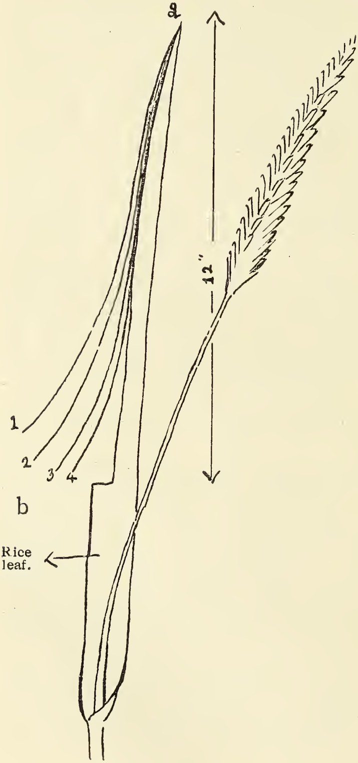

FIG. 1.

Material used and plan of structure.—The material used in the country where I have had opportunities of studying the Baya has been either strips of date leaves or of coarse grass. The colonies that came under my observation this season used strips of the rice plant exclusively. The method of tearing the strips and handling them is both ingenious and interesting. The paddy leaf has a saw edge and is furnished with minute upwardly-directed spines on the several ridge-like, almost parallel, veins. The leaf, therefore, can be pulled through forefinger and thumb only if pulled at *b* (see figure 1). The saw edge and spines do not allow its being pulled in the opposite direction. When tearing off the strips, the Baya makes an indentation on the edge at *b*, about 12″ below the tip *a*, of the required thickness, and by a sideways jerk of the head tears it upwards towards *a*, but not severing it completely at the tip. It now bites through another thickness at *b*, still holding the first undetached strip in its beak, and repeats the operation till it has two strips, but still connected at *a*; it collects a third and often a fourth in the same manner. The bird now flies off, and the pull so exerted, severs the bunch of strips from the leaf at the tip *a*, which trails through the air after the bird. The final jerk often also severs some of the other strips at *a*, which then stream behind the bird as so many individual strips. When the Baya arrives at the nest, therefore, he is gripping the strips in his beak at *b*. He presses the bunch roughly into site. The serrated edge and spines prevent the strips from slipping and falling down. *b* is the only possible working end, and this the bird threads through and pulls out, the roughness operating like the teeth of a ratchet and maintaining the strips in position once they have been properly pulled in. The strip is held down by a foot while the end *b* is being woven in. I have been able to watch this process time and again from beginning to end.

When commencing a nest, the strands are wound and twisted round and round the selected twig until a firm support is secured. From this depends a mass of strips, something like a tassel, which is worked into a transverse loop. This loop invariably forms the skeleton of the structure. Porches are built over the upper part on either side, one developing and broadening out later into the egg-chamber, and the other which is not so bulgy, produced into the entrance tube. Most of the former observers, with the only exception, as far as I know, of Whistler,[1] have laid stress on the fact that the loop is put in at a later stage in the construction, after the nest has assumed the shape of a 'Bell', for the convenience of the hen to perch upon while working on the interior. This is not borne out by facts.

As regards the mud employed in the nests, the purpose of this appears to be obscure. It has been suggested that it is put in to give a correct balance to the nest, and prevent it from swaying violently in the breeze. Jerdon mentions that in one case, which has since become almost classical, he found 3 oz. of mud; this must indeed be exceptional. Of the numerous nests examined by me—certainly over fifty—all contained between 0·5 and 1 oz. The quantity in one seemed unusually large, but when weighed was found to be only 1·4 oz. Considering the normal quantity usually seen, one can hardly imagine it to produce any appreciable difference in steadying the nest in the strong winds which are prevalent during the breeding season of the Baya. Then again, there are some nests in the same colony which have no mud in them at all, and seem to fare none the worse for its absence (see Appendix, 'September 29'). The Oropendolas (*Zarhynchus wagleri*), one of the *Icteridæ* or Hangnests of tropical America which also build woven pendant nests on high trees exposed to violent trade-winds, apparently do not employ any mud for steadying their nests.[2] The purpose of the mud is certainly not to fix fireflies on! I think it is time, however wide-spread and romantic the belief may be, that this story was once and for all put to rest. The mud is stuck into the nest chiefly at the early 'Bell' stage when it remains unoccupied at night (September 27 and 30). If fireflies were really stuck in, it would be only possible to do so at this stage when the mud is still soft. Immediately the mud hardens, the fireflies would perish, thus automatically nullifying the object for which they are alleged to be put in since dead fireflies do not emit any light. Moreover, all the evidence—if indeed it can be called evidence—we have on this point is not only unconvincing but highly questionable.[1] The only explanation one can suggest is that the habit of sticking mud in the nests is a form of atavism—the relic of some ancient custom at one time beneficial to the species. A study of allied forms, their evolution and development may throw some light on this point.

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[1] H. Whistler. '*Birds Notes*'. Vol. V, p. 340. 1914.

[2] F. M. Chapman, '*The Oropendolas of Laboratory Hill*' (Barro Colorado-Panama) '*My Tropical Air Castle*—D. Appleton & Co., 1930).

Share of the sexes in nest-building, and sexual relations.—Dr. Jerdon suggests[2] that upto the time the cross-bar or loop is put into the nest, both birds have worked indiscriminately, but that 'when this loop is completed, the female takes up her seat on it, leaving the cock bird to fetch more fibre and work from the outside of the nest while she works on the inside . . .' Hume endorses this description, and the versions of a great many subsequent writers support the idea of co-operation between male and female from the commencement of building operations.[3] My own observations, however, tell an entirely different story. The interpretation I have put on the sexual life of the Baya with which nest-building is inextricably interwoven, is, as far as I am aware, perfectly new. Before offering it, I have thoroughly tested my facts on all sides as far as lay within my power, and found them to be sound and unassailable, and I feel confident that further independent and continuous observation in the field will confirm my conclusions. I can hardly think of another species of bird whose domestic relations are known to be so bizarre and fascinating except the Oropendolas (*Zarhynchus wagleri*) of tropical South America whose nesting habits are so graphically described by Frank M. Chapman.[4] I gladly acknowledge that it was a perusal of this admirable essay that helped me to overcome my diffidence and to set down on paper what I have suspected to be the case for some time.

Both site-selection and nest-building are done exclusively by the cocks. The adult cocks in full breeding plumage are the earliest to begin, and always keep to colonies of their own. Never has a

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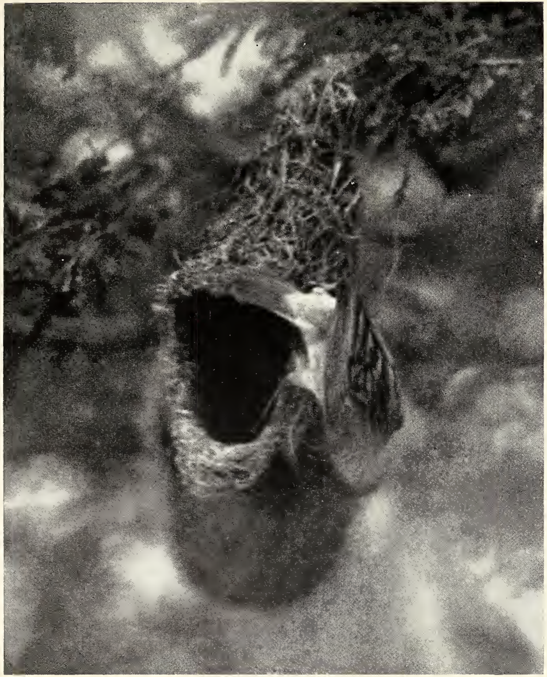
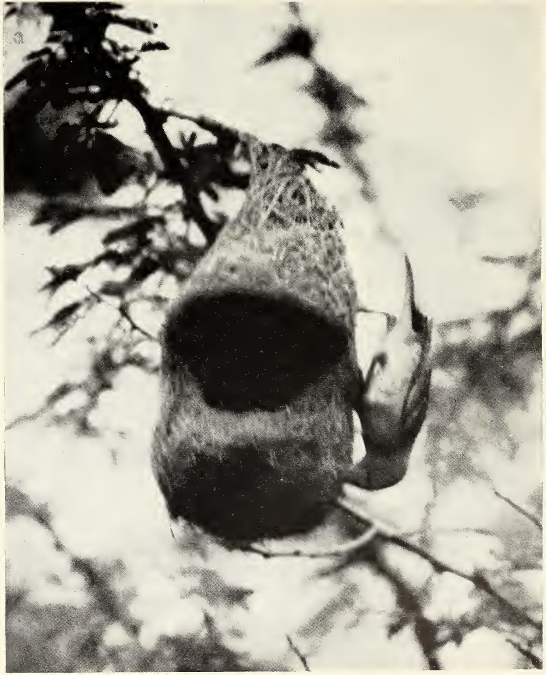
[1] See D. Dewar, '*The Nesting Habits of the Baya*', *Jour. B.N.H.S.*, Vol. xix, pp. 627-627.

[2] '*Nests and Eggs*', Vol. ii, p. 115.

[3] Dr. E. Stresemann has since drawn my attention to p. 344 of his excellent manual ('Handbuch der Zoologie-Aves'—Walter de Gruyter & Co., Berlin, 1928) where, on the authority of C. A. Wood ('The Nest of the Baya Weaver Bird,' Auk 1926, pp. 295-304), and Karl Russ ('Die Webervögel and Widafinken', Magdeburg 1879), he states that the external construction of the nest in this species is carried out exclusively by the male, and that the female only does the internal lining.

[4] F. M. Chapman—'*My Tropical Air Castle*'—D. Appleton & Co., 1930.





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3. A Cock on Nest in an early stage (Note the transverse loop which invariably forms the skelton, being developed).

4. A further stage in the construction.

young cock been observed by me building in company with adults. Young cocks generally take to nest-building late in the season, and likewise have their own separate colonies. Obviously they work without previous training or experience, and just as to the manner born, but seem to lack the requisite earnestness and purpose. In consequence of this a great many—in my experience, certainly *all*—such juvenile nests are never completed, and they are not infrequently of the queerest shapes and most 'unprofessional' appearance. (See Appendix, 'September 25, 26, 27 and 29').

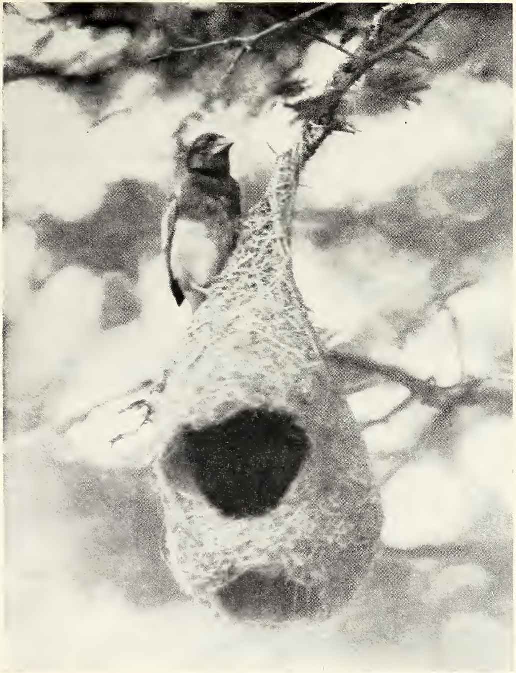
At first I took these young working cocks to be females, but dissection always proved them to be otherwise. Their testes were fairly developed—about the size of small peas—and on closer examination, some of them also showed a tinge of golden yellow on forehead, crown and upper back. It is not unlikely therefore, that some of these young cocks of the first year (?) *may* breed though personally I have never come across such an instance. When at work, they indulge in the same sort of chirruping choruses and fluttering of wings as the adults do. I have never heard a female 'singing'.

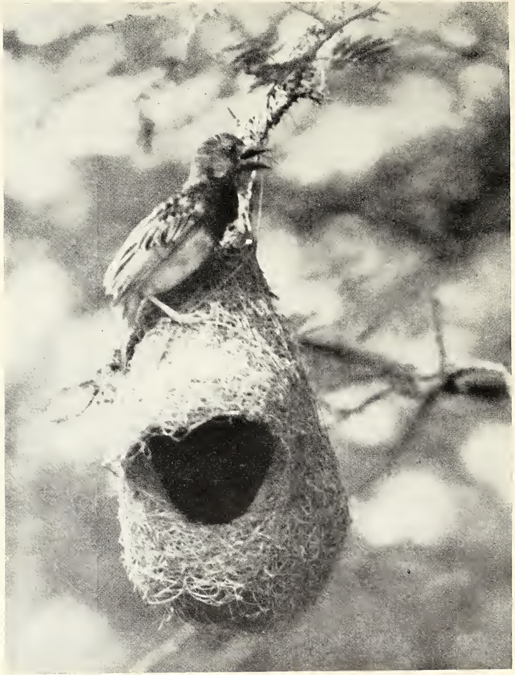
In the initial stages of an adult nesting colony, no hens are as a rule in evidence, and I have been unable to discover their whereabouts during the first few days. It would appear that the instinct to breed, asserts itself earlier in the adult cocks than in the hens, for it is not until the time when the nests have progressed to a stage where the egg-chamber is finished or nearly so, that some of the females first become physiologically 'ripe'. They now visit the colony quite obviously with the sole object of 'prospecting' for laying sites, i.e., to discover if there are any nests that are ready for their occupation. The arrival of the hens at the colony causes a great stir in the community of working cocks, who leave their work and strut about after the hens, pressing their attentions upon them with such impetuosity as often to cause them to retire from the tree. The hens, however, soon return and deliberately visit nest after nest, entering them and sitting on the cross-bar in the absence of the owners who have gone to fetch material. The cock whose nest is furthest advanced, is presumably also the readiest to breed. If a hen is satisfied with a particular nest, she sets about establishing herself in possession. She persists in returning to it again and again on being strutted and chased after by the cock, who gradually gets used to her presence and finally accepts her as his legitimate spouse. Two hens often fight for the possession of an acceptable nest. The successful hen henceforward boldly enters the nest and busies herself with finishing off and making the interior comfortable. In no case have I been able to observe the co-operation between male and female so often described. The lion's share of the building—in fact *all* of it—is undoubtedly done by the cock alone. Her contribution is only the 'interior decoration'. I have never seen a female fetch a single strip of grass, though she may occasionally bring a feather or some vegetable down which is incorporated into the bottom of the egg-chamber. On one occasion I have also seen her bringing a pellet of mud into a completed nest. The hen enters the egg-chamber, and from the movements of the nest while she is within, it becomes apparent that she is pulling and tugging the strips and finishing off the interior. Shortly after occupation, the eggs are laid.

Apart from the strutting and posturing of the cocks, I have witnessed no courtship ceremonials, and in spite of very close watching, not once has actual copulation been observed. (For an exceptional instance which seems difficult to explain, see note, 'October 11'). Copulation certainly does not appear to take place on the nest tree, and, as while the building is in progress the male never leaves the colony except for the purpose of procuring material and feeding, which he seems to do more or less simultaneously, it is unlikely that it takes place outside. From various little movements of the nest and sundry twitterings from within where a cock has followed a hen into the abode, it is my belief that copulation takes place inside the nest where the pair is not liable to be disturbed by the attention of the neighbouring cocks, which would surely be the case if a female exposed herself at this stage for any length of time amongst the band of males without. The cock takes no part in the incubation of the eggs.

The 'building mania' as it has been called, that comes over the adult cock at this season is a sure indication of his readiness to breed, and so long as he continues to build and complete nests, so long is the indication manifest that he is prepared to marry fresh wives. As soon as his first nest is completed and occupied by a hen, the cock takes up the building of a new nest. Leaving the entrance tube of his first nest a moderate length—a few inches—the cock forthwith selects a new twig, which need not necessarily be in the immediate neighbourhood of the first nest (see diagram of Control Colony on September 26) and proceeds to build a second. If he is strong and vigorous, and his instinct to breed sufficiently intense, he completes the second nest also. As soon as the egg chamber is ready or nearly so, the nest is taken possession of by another 'prospecting' female, of which there are several hanging about the colony as the season wears on, and the whole process is repeated till she is also safely on her eggs.

A strong suspicion of the existence of this state of affairs had already crossed my mind after I had had Colony No. 1 under observation for a few days. This colony was however a large one. The number of cocks and hens continually coming, going and hopping about was too unwieldy for adequate control, I could not obtain indubitable evidence here. Fortunately, shortly afterwards I came upon another small colony on a Palmyra palm containing six completed nests and three others at early 'Bell' stages. On each of these latter an adult cock was working, while, though the completed nests were occupied by hens who flew in and out, there were no other cocks in attendance. This was most interesting, and exactly what I had been looking for. I promptly set about trying to discover what the exact position here was. To this end, I drew a rough sketch plan of the colony ('Control Colony') marking the half-built nests and their respective cocks 1, 2 and 3, and the 6 complete nests a, b, c, d, e and f. I carefully noted down the behaviour of the cocks in relation to each of the completed nests. Next day I was again on the scene with a clean sheet of paper, made a fresh sketch plan of the colony and noted the movements of the cocks. This was repeated on two or three subsequent occasions,





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5. After weaving in his bunch of strips, the Cock often perches a while on the dome as if for breath—

6. and joins lustily in the frequent community choruses.

each time beginning afresh and quite independently and with a new sketch plan. The notes I had made (see Appendix 'September 25, 26, 27, 29') were then compared and scrutinized and it was found that my suspicions were well-founded. Each of the three cocks possessed two complete nests occupied by females, in addition to what he was then busy on.

Only one of these three cocks, however, had the breeding instinct of sufficient intensity to complete the third nest, which was in due course also occupied by a hen. In the other two instances, although females visited and inspected the nests on several occasions, the construction never advanced to a stage where they could be appropriated by them. Meantime the zeal of the cocks had begun to flag. They gradually lost interest in the new nests and some time later ceased work on them altogether and busied themselves with tinkering about with their already-completed nests in somewhat casual fashion. Although in this case the cock stopped all further building after the completion of his third nest, it is not difficult to conceive that given stronger stimulus he might have started on a fourth. Whether this would have been completed or not, would depend again upon the force of his building, i.e., breeding instinct.

Here, therefore, is the origin and explanation of the 'Cock Nest' theory which presupposed that the cock made these shelters by way of outlet for his super-abundant building energy and for his own special benefit, to serve as a protected perch for him to roost in. Not only is any such implication unwarranted by facts, but I have further ascertained (notes, September 30, October 1, 2 and 8) that at night the cocks do not roost in the nest-tree at all, but fly off long distances every evening to some common roost which I was unfortunately not able to locate. On a previous occasion in November, I came upon a patch of tall, coarse grass in Salsette where hundreds (they may have been a thousand !) of Bayas were roosting at dusk. The din of their chatter was audible a good three-quarters of a mile off. It was probably some common roost of this nature that was resorted to in this instance every evening by the cocks and unmated hens.

Coming now to the number of eggs laid by the Baya. In my experience, and that of numerous other observers, two to four eggs constitute a normal clutch. Where more than this number occur, it is generally conceded that they may be the product of two or more hens. According to my interpretation of the sexual relations of the Baya this laying by two or more females in a single nest is not difficult to account for. A female whose physiological 'ripeness' for egg-laying has been delayed through some cause or another, often arrives at a colony late in the season, to find that there is no nest available for her to occupy. She moves, and is chased about, from nest to nest until she comes upon one which already contains eggs, but is unattended. (The hens at this stage leave the nests to themselves for considerable periods during the heat of the day). She promptly enters and surreptitiously depositing her egg, is off again. Next day, she bides her opportunity and repeats the performance, and it is possible that owing to the paucity of laying sites, a third hen may also be driven to utilize this same nest.

Now, if my theory about the copulation taking place inside the nest holds, then I believe in a case like the above, it is possible that a hen who has slipped in surreptitiously and probably without drawing the attention of the cock and thus gone untreaded by him, may lay eggs that are infertile. I suggest that a greater number of eggs than the maximum normal clutch of four, is found in nests chiefly at the end of the breeding season when no fresh building work is being done by the cocks, thus necessitating hitherto 'unpossessed' hens to resort to occupied nests. This was certainly the case in the only experience I have personally had in Sind of finding seven eggs in one nest. Most of the other nests in this colony contained chicks, and fresh building appeared to have been in abeyance for some time.

Further, while many observers have, time and again, found six to eight eggs in a nest, and in one case as many as eleven,[1] is it not significant that no one ever seems to have recorded more than four *chicks* in a Baya's nest? Though this is frankly pure speculation, and much more observation is needed on this point, does not the above lend colour to my suggestion that the extra eggs, over and above the maximum normal clutch (presumed to be the work of a second or third female) are infertile consequent upon the peculiar sexual relationship of the species?

My observations may be summarized as follows :—

1. The Baya is polygamous, not in the ordinary sense but in a manner of his own. The number of his wives depends upon the number of completed nests he is able to build for them, a factor dependent on his potency—in other words, on the force and intensity of his breeding instinct.
2. The hen takes no part in the building of the nest except 'interior decoration' at a late stage.
3. Incubation is carried on solely by the hen.
4. Feeding the chicks is done mainly by the hen. This instinct is also present in the cocks to a small extent, but is indulged in only late in the season after the building mania has run its course.
5. The 'Cocks' Nests' are nothing more than abortive attempts of the cocks, whose zeal for building has petered away while they are engaged on the work.

A remarkable thing which will be seen from my notes is the persistence with which a pair of White-throated Munias (*Uroloncha malabarica*) haunted Colony No. 1. That this was not just an exceptional coincidence is shown by my record on September 26 relating to Control Colony, where another pair was also observed behaving in a like manner. It was not unknown to me that this species occasionally lays in the disused nests of Bayas. I had on previous occasions, frequently observed pairs going in and out of old Baya nests, and on April 6, 1924, had actually taken four eggs from one into which a Munia had been noticed entering. Again, on visiting Baya Colony No. 1 on December 12 this year (1930), I discovered that one of the now deserted nests was occupied by a pair of Munias who flew in and out of the long entrane tube with perfect ease. This nest contained a brood of clamouring young, while a neighbouring nest was also tenanted by a second

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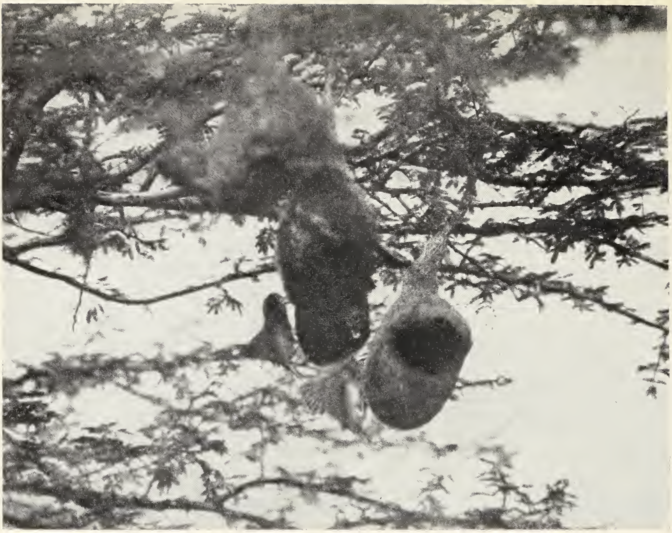
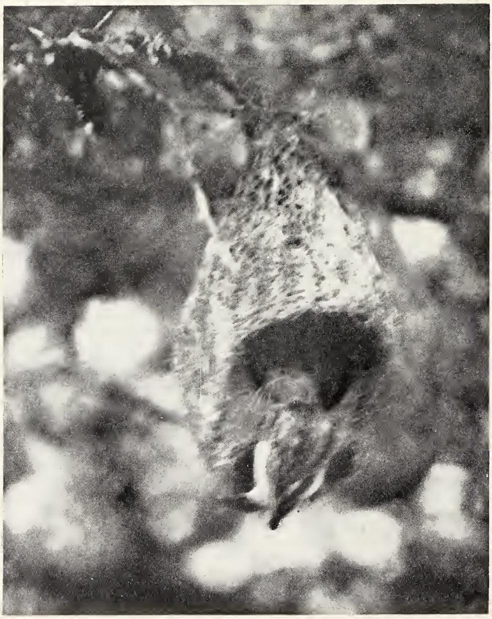
[1] '*Nests and Eggs*', Vol. ii, p. 119.



7. All the builders flutter their wings and join in the choruses, in whatever position they happen to be at the time.



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8. Pilfering material from neighbouring nests is extensively practised by certain 'habitual offenders.'

pair and probably contained eggs. This conduct of the Munia provides interesting food for conjecture. If the bird laid in disused nests, it would only succeed in avoiding the labour of building but would still have to incubate the eggs itself. If on the other hand it was successful in slipping into an unguarded Baya nest, whence the brooding hen had gone out (as actually happened on September 18) and in laying its egg there, it would be, quite involuntarily, but with good effect all the same, compelled to retire on return of the legitimate occupant, leaving its egg to be hatched by the Baya. Would such a process not tend, in course of time, to develop into, and establish, a habit of systematic and voluntary parasitism as has been observed in some African Weavers?

Unfortunately, so far I have not been able to secure direct evidence of the Munia actually laying in an *occupied* Baya nest, but I feel certain that its actions will repay careful watching.

My thanks are due to Dr. Erwin Stresemann of the University Zoological Museum, Berlin, for kindly reading over my Manuscript and referring me to some valuable literature on the subject.

APPENDIX

Extracts from my Field Note Book Relating to Nesting of Bayas, Season 1930.

August 19.—Colony No. 1. Only males in breeding plumage at work on nest-construction ; none in off plumage. No females about. Arrival of a hen caused a flutter amongst the working cocks. So much noise and excitement resulted that she soon withdrew. Much pilfering of material goes on. *A* pilfers his neighbour *B's* nest while the rightful owner is away to fetch strips. Later, in the absence of *A*, *B* makes up for the loss ! There are evidences of a guilty conscience in the furtive glances of the robber and in his hasty withdrawal on the approach of the rightful owner ! A number of nests are nearly ready, apparently only wanting the entrance tube. Where are the females ? When and how will they appear on the scene ?

August 20.—Another colony No. 2 building on a Palmyra palm also consisted exclusively of males in breeding plumage.

August 21.—Activities at Colony No. 1 were marked this morning by the presence of several females Immediately one of these appeared, there was a general commotion amongst the cocks, who pursued her strutting from branch to branch, often following her when she flew off to a nearby tree. The females thus driven off, returned again and again. Their object appeared to be to inspect the progress of the building work, and one female would visit several nests successively while the respective males were away to fetch material.

In Colony No. 2 there was only one nest at the advanced ' Bell ' stage with the egg-chamber nearing completion, where a female was also seen at work, the cock on the outside, she within. The work on the interior is done by the birds sitting on the cross bar . . . .

August 22.—Watched Colony No. 1 for 3 hours. Females arriving and entering nests. Do they mate by establishing possession of a nest ? A pair of *Uroloncha malabarica* came and made itself at home in the colony to the extent of one bird entering a half-built nest and sitting on the cross-bar while the other perched on the dome. Owner was away at the time. All the nests at the ' Bell ' stage have mud inside, near the egg-chamber. Saw a cock collect some from the neighbouring swamp and stick a lump inside his nest.

August 24.—Again observed a pair of *U. malabarica* loitering amongst the nests in Colony No. 1, frequently entering the nests in the absence of the owners.

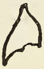
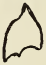
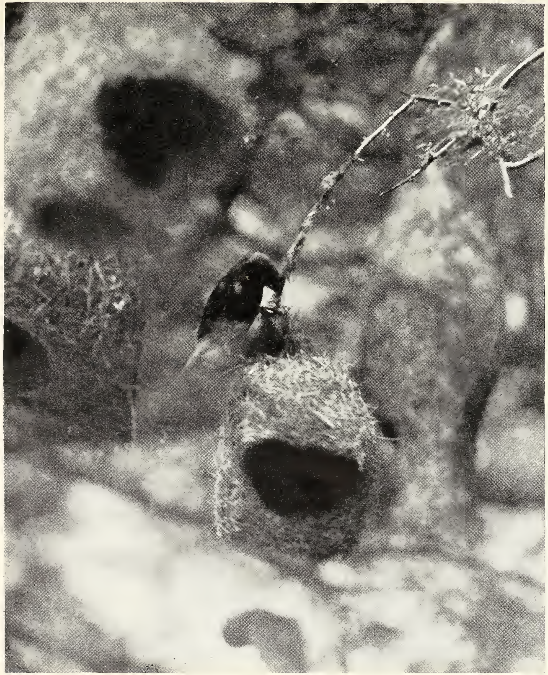
August 28.—Spent half hour at Colony No. 1. Made following notes on the spot : ' Saw lumps of mud being brought by the male and stuck in at this stage.  A number of nests at this stage  were found wrenched off and lying on the water below. This could not be the work of a squirrel as the tree stands isolated in water. A cock who had one nest completed, with about 3″ of entrance tube, had commenced another about two feet away from this. He was pilfering material from his neighbour freely, hastily pulling out three or four strips while the owner was away. This bunch of strips, he first pressed roughly into site with his bill, then each one was woven in individually. The foot is used to hold one end down while the other is being worked through. Much and continuous attention is given to the support ; whenever the cock is sitting idle, he goes on working at this, pulling the strips taut and trying to reinforce the suspension further. In some cases these supports wind round for over a foot of the twig. Often when the nest is completed, fresh strands continue to be brought to fortify the hanging. Appear to have a rigid moral code ! When an owner returns and finds his nest mauled about and his immediate neighbour with a beak-full of filched strips, which from their colour are obviously not fresh ones, he never goes for him bald-headed on suspicion. He proceeds to repair the damage in the most matter-of-fact way. A scuffle only ensues if the robber is caught red-handed. The birds, with claws locked, whirl round and round in the air dropping till within a few inches of the water when they separate and each returns to his nest. On one occasion they actually touched the water with a flop ! '

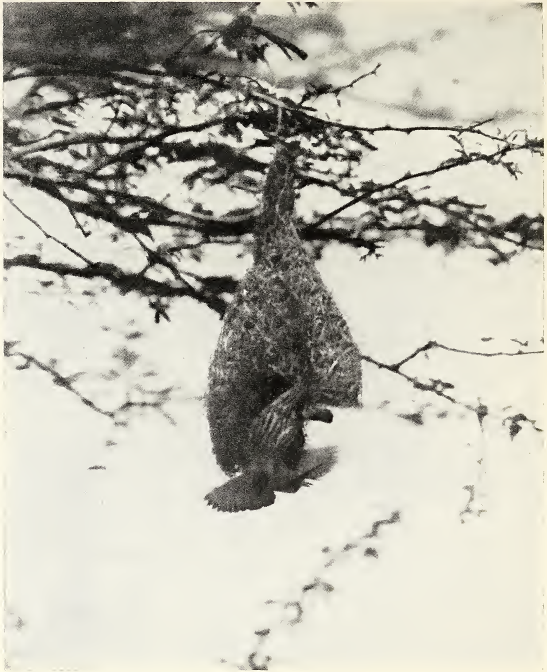
FIG. 2.

FIG. 3.

September 18.—In the interval since my last note, there have been ten days of continuous and heavy rain—over 35 inches. The water round the tree at Colony No. 1 is thigh deep. . . . To-day's observations confirm my suspicions regarding the sexual life of the Baya. I believe that when a nest is nearly completed, a female takes possession of it. The females sometimes fight for possession. In course of time the cock becomes accustomed to her presence. From this stage on, when the nest is nearly complete, she works at the interior, he without. I have not observed co-operation between the two as has often been described, of his passing the end of a strand to her inside and her returning it through the wall of the nest. The egg-chamber having been properly smoothed and ' decorated ', she lays the eggs and commences to incubate sometimes even before the entrance tube is begun. When a cock has finished one nest and a hen has ' accepted ' it, he forthwith begins another as an outlet for his building mania. If he has sufficient ' push ' left to bring it near completion, it may be that another female whose physiological cycle has been delayed, but is now mature, comes along and takes possession of it, otherwise it remains half finished—at the stage that has so often been described as ' Cock's Nest '. Found a completed nest snipped off and lying on the water below. Examination showed that the support had been cut clean through. It could not have been blown down by strong wind. Looks like doing of the bird itself—probably that of a disappointed suitor ! It contained two eggs, white with fresh pink tinge ; pointed long ovals 21 × 13 and 22 × 13·5 mm. respectively. In the nest there was only one little daub of mud above and to one side of the egg-chamber, weighing roughly ½ oz. No insect remains in mud ! A pair of *Uroloncha malabarica* still haunting the colony, trying to enter tubes of completed nests and being repeatedly assailed by cocks. Photographed one about to enter a completed nest (but without any entrance tube). Both birds entered and remained inside for fully five minutes, but left hurriedly on arrival of occupant hen who entered the nest and stayed within for over ten minutes. Later this nest was examined. It contained two fresh eggs, but both Baya. Three or four more nests were examined at the full ' Bell ' stage and where the egg-chamber was nearly completed. Mud in each roughly not more than ½ oz. No trace of fireflies !



9. A Cock, dissatisfied with his partly-built nest, works in dead earnest for its undoing.



10. Sometimes two females fight for possession of an eligible nest.

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September 23.—Spent 3 hours at Colony No. 1. A half finished nest was found floating underneath the tree. Examination showed that the suspension had been severed just where it expands into the 'Bell'. Am convinced that this was the doing of the cock himself, as a bird was observed destroying the support of another half-built nest in the same way. He was working away at this, undoing quite seriously and deliberately, stopping every now and again to flutter his wings and join the communal choruses. By the time I left, the connection was nearly severed. Saw one hen carrying some mud in her bill, entering a nest she had taken possession of. Even the 'sitting' hens are molested by the cocks working in the proximity when she arrives to enter her nest, and their attentions compel her to make a rush for the entrance. There was, throughout my vigil to-day and on the 18th, no cock in attendance on the nest which was examined by me then and found to contain 2 eggs. The same was the case with several completed nests also which were obviously occupied —females leaving and re-entering—and to my mind this indicates that the cocks are busy on further nests. The nest found on the water contained 2 patches of mud on side of, and above, egg-chamber. Altogether the quantity must weigh between $\frac{1}{2}$ and $\frac{3}{4}$ oz.

The pair of *Uroloncha malabarica* made several attempts to enter the nests but retired disappointed.

September 25.—Visted Colony No. 2. It has been entirely deserted, practically every one of the completed nests being torn open near the egg-chamber, and hanging in tatters. The members of the colony have obviously dispersed, and are now to be seen on a great many 'Ber' trees in the surrounding paddy-fields, working in colonies of from 2 to 8 nests. On one Palmyra palm, about 400 yards from Colony No. 2, there hang 6 nests completed and occupied by hens, and 3 more in early stages. Only 3 males in breeding plumage were at work here—one on each of the latter—throughout the time I was watching (about 40 minutes), and I feel convinced that some of the cocks were responsible for 2 or more of these nests.

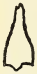
On a Ber tree close by, there were 2 nests at the 'Bell' stage, on one of which a young male (?) was at work. They both looked most 'unprofessional' thus :  and it seemed as if the workers were trying their hand for the first time! The young male who flew off occasionally and fetched strips, was in juvenile or female plumage, slightly brighter on the breast.

FIG. 4.

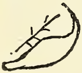
At Colony No. 1, 2 hens were seen carrying green caterpillars into nests. Two nests hanging by long thin suspensions, have come to grief having been caught up in the thorns presumably while swinging about in strong breeze, thus : 

FIG. 5.

This would indicate that long suspensions can be a disadvantage.

September 26.—A bird in female plumage working on one of the 2 'amateur' nests recorded on 25th. From time to time he fluttered his wings and uttered '*chit-chit-chit*' followed by the chorus of '*chi-whi, chi-whi, chee-ee-ee-ee.*' On another small Ber tree hard by, a colony of young cocks in juvenile plumage working away on several nests in early stages. In some individuals, there is a suggestion of yellow tinge on forehead, back and breast. There is no adult cock in this colony of about 12 nests.

To determine the exact status of each of the 3 cocks recorded working on half-finished nests yesterday on a Palmyra palm containing 6 completed nests besides, which I shall henceforward call '**Control Colony**', I went out this morning with paper and pencil and spent 3 hours watching the birds. Observation fully confirmed my surmise that each of the cocks owned more than one nest. I transcribe in full, the notes made on the spot :

'6 nests already occupied by hens : 3 under construction. All the latter are at 'Bell' stage. Only 3 adult cocks in breeding dress in the colony. Among the working birds, one or the other occasionally goes and perches on a completed nest when female enters. From some, he is driven off by a neighbouring cock, while if perched on another he remains unmolested. Rightful ownership ? A pair of *Uroloncha malabarica* persistently trying to enter nests and being constantly driven off by cocks. A hen twice seen flying into a nest with soft material for lining—once ascertained to be vegetable down. Made sketch plan of colony, thus :—See Fig. 6, p. 960.

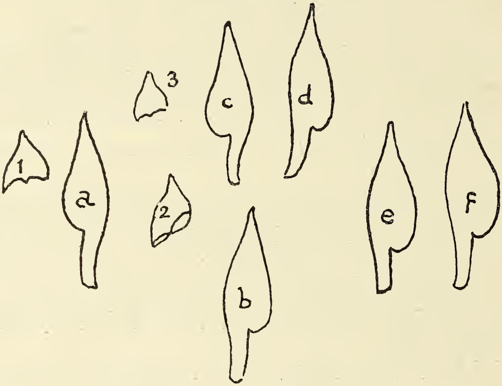


FIG. 6.

♂ 1 observed reinforcing *a* with an additional strip, unchallenged by other cocks.

A good deal of jealousy prevails amongst the cocks, and fights are common; they whirl round and round in the air grappling with each other till almost on the ground. Birds flying into paddy-fields and eating tender paddy grains from the ears. Females leave nest off and on and visit fields, evidently with the same object. The strands brought by the cocks are about 12″ long.

♂ 1 put in another strip to *a*. 2 was twice visited by an outside hen, who entered 'Bell' and sat on the cross-bar, flying off when the cock arrived and commenced to flutter his wings, hanging on the outside head downwards.

♂ 3 visited *e* and adjusted a strip.

When ♂2 visited *a* and clung on the entrance as if he would enter, ♂ 1 left his work on 1 and attacked him, both falling in the scuffle till almost on the ground.'

September 27.—Again visited Control Colony and started investigations afresh drawing a fresh sketch plan of the nests. Made following notes : 'Same cock observed working at strengthening exterior of egg-chamber and rim of entrance tube of *e* and *f*.

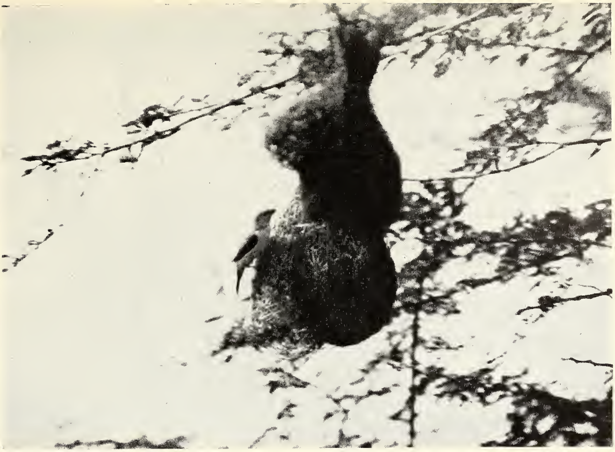
Another cock reinforcing *a* and *b*.

Egg-chamber of 2 nearly ready. 1 and 3 still at advanced 'Bell' stage.

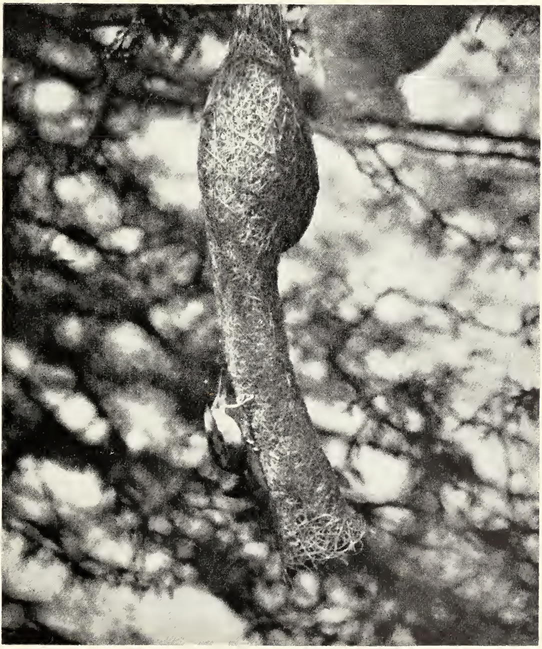
A fourth cock came from outside and tried to perch on *d*, but ♂ 2 left his work at 2, attacked and drove him away. The fourth cock was never seen again.

♂ 2 then sat for a while on *d* preening his feathers unchallenged. ♂ 2 observed strengthening suspension of *d*, and then returning to 2.

♂ 1 went near 3, presumably to pilfer material ; cock working on *f* left his work, attacked and drove him away and came back to *f*.



11. A pair of White-throated Munias (*Uroloncha malabarica*) persistently haunted Colony No. 1, and entered and left the nests freely.



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12. When fresh building work is finally abandoned, the Cocks often occupy themselves in elongating the entrance tubes of their nests.

♂ 2 busy reinforcing exterior of egg-chamber in 2, and later, entrance tube of *d*. He entered it while the hen was away and did some pulling and tugging on the interior. Came out and tinkered about with entrance tube of *c*, and then hopped across to 2.

Females don't do serious work on exterior but are occasionally seen casually pulling at a strip as they sit on the nest prior to entering.

Strong breeze blowing. ♂ 2 reinforcing suspension of *d*. From here he hopped on to *c*, put in a fresh strand and then returned to 2.

A female visited 2, and was chased by ♂ 2 fluttering.

♂ 1 visited *a*, did some repair and returned to 1. A female visited 1.

♂ 3 visited *e* and put in a strand.

♂ 2 working away industriously at *d*, bringing fresh green strands and weaving them in, chiefly round bottom (exterior) of egg-chamber and rim of entrance tube, also adding fresh strips to *c*.

I have now no doubt that *a* and *b* belong to ♂ 1.
c and *d* belong to ♂ 2.
e and *f* belong to ♂ 3.

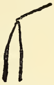
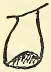
At the colony of young birds, recorded on 26th, the nests as far as they have progressed, are untidy and 'unprofessional' structures. One is more or less just a rough tube (solid) from suspension, about 15″ long and 3″ in diameter, thus  Another thus: 

FIG. 7. FIG. 8.

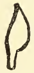
Took census of Colony No. 1. Completed nests  25; at full 'Bell'

FIG. 9.

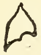
stage about 8; in early stages or incomplete 'Bell'  about 8. Total includ-

FIG. 10.

ing deserted beginnings, 47. This excludes a number in various stage (but mostly 'Bell') discarded for some reason or another and found lying on the water underneath the tree. The number of cocks was counted variously between 10 and 12. They were certainly not more, but may have been less. A cock was adjusting strips on the nest examined on 18th and found to contain 2 eggs, and into which a hen was noticed entering with a caterpillar some days later. He subsequently entered the nest and remained within for about 5 seconds. Has never been seen to take an interest in the nest before.

Visited Colony No. 1 again at 8 p.m. with electric torch. No birds sleeping in uncompleted nests or roosting in the tree. No fireflies!

September 29. Visited Control Colony again this morning to confirm previous observations regarding ownership. Started afresh, quite independently making a new sketch plan of the nests. Nest No. 2 was complete except for the entrance tube, and a hen was seen flying out of it while the cock was working on the exterior. She has obviously taken possession. Made the following notes on the spot: 'While nest 2 is ready, 1 and 3 appear to have made small progress since the 27th. From *e* a cock jumped across to 3 and proceeded to weave.

♂3 visited *e*, and returned to 3.

2 has assumed a more smooth and finished appearance. ♂2 hopping across to *c*, adjusting a strip and returning to resume work on 2. From jerky movements of 2, it appears that hen is working within.

A cock brought fresh strips to *c*—adding them on exterior.

♂1 on *b*. An outside hen visited 1. ♂1 struttingly returned to 1, driving and chasing her away by his impetuosity. ♂1 visited proximity of 3; cock working on *e* left his work and chased him off. ♂1 later returned to *a* and commenced tinkering about.

♂2 flew off and returned with fresh strips in 40 seconds. On another occasion in 50 seconds.

♂1 seems to have become rather indifferent to his half finished nest, and spends most of his time on *a* or *b*, or in the neighbourhood, doing little.'

To-day's observations confirm yesterday's conclusions.

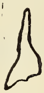
At the colony of young cocks in the Ber tree, the untidy hanging sketched on the 27th has taken shape; a nest is forming at the extremity, thus: 

FIG. 11.

All the birds working in this colony are in immature plumage with a faint tinge of lemon yellow in some individuals on breast and forehead, although the latter is still streaked. One of the 2 amateurish nests sketched on the 25th, has been snipped off at the suspension and now hangs by a single strand. A third nest has been commenced on the same tree, lower down. In these imperfect nests it was also noted that mud was being brought and stuck in.

At Colony No. 1, work seems to be more or less at a standstill. A number of nests remain half completed, but from the colour of the strips it is apparent that not much fresh material has been put in. The cocks spend most of their time in singing and hopping and strutting about after the hens as they arrive or leave the nests. Several hens seen carrying grasshoppers and caterpillars into their nests—no cocks so far seen assisting in this. The females utter *chit-chit-chit-chit* before shooting up the entrance tubes.

Some males were observed at Control Colony eating a few grains of paddy before tearing off strips. The suspensions of the nests were being constantly added to by the respective cocks.

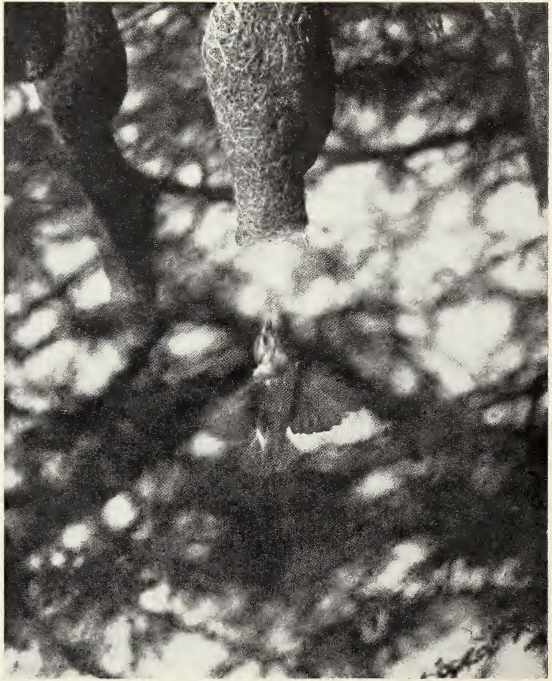
Took down nest (examined on 18th at Colony No. 1 and found to contain 2 eggs) and brought it home. Contains 2 chicks, blind but with quills sprouting along spine and on wings. Sparse down on head stands erect when clamouring for food and being fed. Gape rich lemon yellow; inside of mouth bright orange. These colours certainly help to make the mouths conspicuous in the darkened interior of the nest. This nest contains no mud whatsoever. A couple of large white (egret ?) feathers are incorporated in the lining of the egg chamber. There was no mud in a fully completed nest found lying on the water under the tree.

Visited Colony No. 1 at 6·15 p.m. with a view to find out where the cocks roost at night. Just before sunset, and upto the time they left the colony activity seemed to be at its highest and a great deal of noise prevailed. Actual building was little, but there was much singing and fluttering of wings and hopping about from branch to branch, the cocks pressing their attentions on the hens About 10 minutes after sunset, small parties of 4 or 5 flew off in a southerly direction. After 3 or 4 such parties had departed, silence pervaded the colony. Only the hens in occupation of nests were left behind. A number of these sat about the adjoining twigs, preening their feathers and uttering *chit-chit-chit*, and gradually flew up their respective tubes, one after another.

The parties that left comprised of cocks as well as hens, probably such as had come prospecting for nests. I watched these bands disappearing over the trees about 2 furlongs distant.

October 1. Took up position at sunset on a mound near the trees over which I had observed the parties disappear last night. With binoculars I could see activities at Colony No. 1 and also mark the parties as they left. They came along soon after sundown over the trees, and continued further till they disappeared over another clump a further 2 furlongs to the south.

October 2. Visited Control Colony. ♂1 appears to have lost interest in nest 1, which continues to remain at open 'Bell' stage. He spends most of his time tinkering about with *a* and *b*, particularly in elongating the entrance tube. The tubes of *a* and *b* are longer than those of the other nests in this colony;



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13. Some birds alight on a neighbouring branch before flying into the nest with food for the young.

14. A Baya shooting up the entrance tube of its nest is a wonderful sight.

that of *b* being fully 12″. ♂3 has also lost interest in nest 3 which also remains at the open 'Bell' stage. He is mostly on *e* and *f*, pulling the strips and occasionally adding a couple of fresh ones. Nest 2 is complete with the entrance tube 2-3 inches long. It is occupied by a hen who entered and left every few minutes unchallenged by ♂ 2, who was absent for some time but later came and sat on 2.

Activities at the young male colony in the Ber tree also appear to be flagging.

Posted myself at sunset along the route of the homing Bayas, near the clump of trees over which they had last disappeared, with Mahmood nearer the nest tree to warn me of their approach. About 5 minutes after sunset a party of 8 came along and flew over me, but disappeared over another clump a further two furlongs approximately. They were flying strongly when last seen and showed no signs of alighting.

October 3. A Crow Pheasant (*Centropus sinensis*) alighted in a neighbouring Ber tree about 25 feet distant from Control Colony. He was attacked by all the 3 males as soon as he showed himself at the top, and forced to withdraw into the foliage. On the cocks sounding their peculiar drongo-like *chit-chit* of alarm, the hens rushed out of all the seven nests and joined them in mobbing him. The hens soon re-entered their nests. A little later the Crow Pheasant again exposed himself at the top. The cocks repeated the attack and on their warning cry the hens again sallied forth, and the Crow Pheasant retired to the bushy centre of the tree. No attention was paid by the Bayas to a pair of Koels (*Eudynamis scolopaceus*) in the same tree.

At Colony No. 1 building activities seem decidedly on the wane. A cock was observed perched complacently, half fluffed-out, and with abdomen resting on twig and a bunch of fresh green strips in his bill, for well over 5 minutes! He later leisurely proceeded to weave this into a completed nest. Many hens are engaged in bringing food for the young, whose incessant cheeping now adds to the liveliness of the colony. Mostly green caterpillars and green nymphs of grasshoppers. Feeding done by hens alone? Counted 8 as the largest number of cocks present in the colony at any one time.

Immediately after the suspension is made, a rough transverse loop is put in; thus this invariably forms the skeleton round which the structure is built.

A mass of droppings on the ground immediately under a nest is a sure indication that it contains young.

October 8. By the 'Relay System' I was able to trace the cocks and nestless hens of Colony No. 1 for over a mile and a half towards their roosting place at sunset. They disappeared over some tall Casuarinas, flying strongly, and I have no further hope of locating their roost which is obviously a great distance away.

October 9. Spent 3 hours at Colony No. 1. Females busy feeding young. Green grasshoppers appear favoured. Where the chicks are very young (as I afterwards ascertained) the mother would often perch on a twig before entering nest, and pull off the harder portions of the insect, such as the legs and head, and carry only the soft body to the chicks. Cocks were doing no new work, but one or the other would occasionally bring a fresh strip or pull one out of some half finished nest and weave it into an already completed one. They did no feeding, but 'fooled' about in the tree, fluttering their wings and chirrupping every now and again. One cock did bring a brown caterpillar once, but perched with it in his bill listlessly on the nest as if at a loss how to proceed for a couple of minutes, and finally solved the puzzle by swallowing up the insect himself! Examined 11 nests for contents, either by snipping off entrance tube near egg chamber or slitting up the whole length till opposite egg-chamber, with a pair of scissors. Six nests contained chicks between 5 and 8 days old, two in every case. In the seventh nest the two chicks were grown enough to flutter out while the nest was being handled. The 8th nest contained only 1 egg; the 9th 2; the 10th 3; and the 11th 4.

October 10. At Control Colony nest No. 1 has fallen down. 3 has been abandoned at the full 'Bell' stage. ♂ 1 occupies himself now chiefly with elongating entrance tubes of *a* and *b*. That of the latter is now fully 2 feet long. ♂ 2 and ♂ 3 also tinkering about with their nests, fluttering and chorus singing.

At Colony No. 1, the cocks are busy 'seaming' up the slits made by me yesterday with fresh green strips, which appear as neat green stripes down the centre of the entrance tube. Where the entrance tubes were snipped clean off, a fresh green collar has been added which is being developed into a new entrance tube.

October 11. Spent 3 hours at Colony No. 1. The feeding instinct seems to be present in the cocks, but so far is very weak. Some were seen bringing insects but they would perch on the nest or on an adjoining twig and hop about from one to the other uttering the *chit-chit* of alarm (warning notes) and not knowing how to proceed. In some cases they entered the nests after much dilly-dallying while in others the insects were swallowed up by the birds themselves ! A female arrived from outside ; a cock strutted up to her and without any preliminaries jumped on her back and treaded her. I am unable to say if copulation was really effected but he went through all the actions during the exceedingly short time he was on her back—about ½ second. Immediately after this, the hen flew off in the direction of the nightly roost, and was seen flying strongly and directly over a clump of trees about ¼ mile away. What is the significance of this episode ? I have never seen anything like it before ! Mud in a nest whose young have already left weighed 1·4 oz.

October 13. . . . A Shikra (*Astur badius*) stooped on Colony No. 1. The cocks who appear to act as sentries and watches of the colony, immediatey made a great noise with their drongo-like *chit-chit* alarm calls. They dashed off from the tree to one across the tank, accompanied by some of the hens, and continued to sound the alarm for a considerable time after the death of the aggressor at my hands. Some of the hens shot into their nests, and for a time there was complete silence from the chicks. The hawk had failed to secure a bird. His stomach dissected was quite empty.

A cock at Control Colony was seen carrying a green grasshopper into nest *e*.

October 17. Examined 9 nests at Colony No. 1. Five contained 4 nearly full-fledged young each. Two contained 3 chicks each and one 3 eggs. Only one nest contained 2 chicks. Cocks now taking greater part in feeding. One fully-fledged chick, in trying to escape, fell in the mud under the tree, and was seized like lightning by a Bull Frog (*Rana tigrina*) of which there were a number lying in wait (?).

October 22.—At Control Colony, ♂ 1 was observed plucking and conveying green paddy grains into nest *a*.

Nests *e* and *f* have a lateral hole near the entrance to their tubes which have been somewhat widened at their ends. The fresh green strips woven round the rim, show that the work is recent. Looks as if another storey was being added. This is in all probability the work of the legitimate owner (cock) himself as none of the other nests belonging to other cocks have it.

The cocks appear to feed the chicks only in one of their several nests—the favourite one (! ?) In 2 cases I was able to ascertain definitely that their attentions were confined to the latest nests of their series.

INDIAN DRAGONFLIES

BY

F. C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXXVI

(*With seven text-figures*)

(*Continued from page 107 of Volume XXXIV*).

Genus LESTES, *Addenda.*

[1] **Lestes patricia** Fraser

Lestes patricia Fras. *Rec. Ind. Mus.* vol. xxvi, p. 486 (1924).

Male. (Female unknown.) Hindwing 24 mm. Abdomen 37 mm.

Head: Labium greyish; labrum, genæ, epistome, and frons azure blue; vertex and occiput matt black; eyes deep azure blue above, turquoise blue beneath (fading to olivaceous brown after death).

Prothorax greenish-blue laterally, matt black above.

Thorax bluish-green on the dorsum and laterally, pale greenish-white beneath. Dorsum marked with a broad stripe of matt black extending out to about halfway between the dorsal carina and humeral suture and with straight borders. Laterally the upper portion of the area between the humeral and postero-lateral sutures greyish-green, whilst beneath are two pairs of black spots partly obscured by pruinescence.

Legs bluish outwardly, reddish on flexor surfaces, black on the extensor; femoral spines short, tibial long. (About 11 spines on the femora.)

Wings hyaline, palely enfumed, this especially noticeable with the wings superposed; pterostigma dark brown, about four times as long as broad; 14 postnodal nervures in forewings, 10 in the hind; discoidal cells equal; *ac* situated midway between the antenodal nervures.

Abdomen bluish-green marked with matt black on segments 1 and 2, and from segments 6 to 10; segments 3 to 5 warm brown dorsally, non-metallic. All segments with a broad dorsal stripe which dilates apicad but does not extend quite to base of segments; segment 1 with its basal half only black, 2 with a mid-dorsal stripe slightly dilated apicad, 7 with the dorsal stripe gradually widening apicad, whilst segments 8 to 10 are entirely black, the last two being somewhat pruinosed dorsally.

Anal appendages.—Superiors black with the inner dilatation white, this latter rather broad and with a robust black tooth at its base; apical ends turned in abruptly at nearly a right angle and with a few small spines on the outer border. Inferiors very short, digitate, extending nearly to the end of expanded part of superiors, apices naked, obtuse, black.

Distribution.—Coorg only. The type insect is the only specimen known and is in the author's collection. It was found lurking in bushes beside a small pond near Virajpet, on the Sidapur road. It bears a superficial appearance to *C. pulcherrima* and is easily distinguished from other Indian species of *Lestes* by the single mid-dorsal black band with straight borders.

(The description of this species should follow directly after that of *L. viridula*, Part xxxiv, vol. xxxiii of this Journal.)

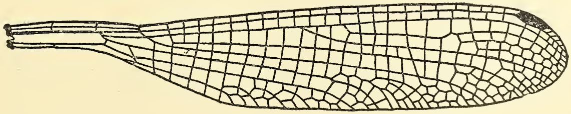

FIG. 1. Forewing of *Burmargiolestes melanothorax* (Selys.)

Subfamily MEGAPODAGRIONINAE.

Podagrion Selys, *nom. preoc.*, Syn. Agrion. Bull. Acad. Belg. (2) xiv. p. 12 (1862) ; Id. Mém. Cour. xxxviii, p. 40 (1886).

Dragonflies of medium size, usually of more robust build than the average Cœnagrionine, body colouring non-metallic, resting with wings widely or partly spread. Wings with a long petiole, narrow, hyaline, discoidal cell elongate, moderately narrow, variably acutely angulated distad ; sectors of arc arising from lower half of arc ; *R3* arising far distad of node ; origins of *IR3* and *R4+5* variable ; *Cu2* arched slightly costalwards at its origin ; no oblique vein present between *R3* and *IR3* ; pterostigma variable, usually slightly more than twice as long as broad ; intercalated sectors present in most, especially at apical area of wings, these sectors giving a pectinated effect to *IA* and *MA* in some species ; anal bridge vestigial or complete. Abdomen long and slender or moderately long and robust, especially in the females. Superior anal appendages of male usually more or less forcipate ; inferiors vestigial.

Genitalia. Lobe usually depressed, hamules large and prominent, penis with the end culed over its stem and ending in two long, more or less curled branches which embrace the stem, lobe tumid, more or less pyriform. Vulvar scales very robust and extending well beyond end of abdomen. Larvæ unknown.

Distribution. Only three genera are known from within Indian limits, beyond which the subfamily extends throughout the tropics, neotropics, Australasia and the Philippines.

The three Indian genera stand somewhat isolated in the fauna, each being represented by a single species within our limits and all confined to the north-east districts and Burma. *Burmargiolestes melanothorax* Selys, which was formerly included under genus *Argiolestes* has since been placed in a genus of its own, so that the distribution of this species is no longer anomalous. A Rhinagrion which I had incorrectly placed as *M. tibetana* turns out to be a

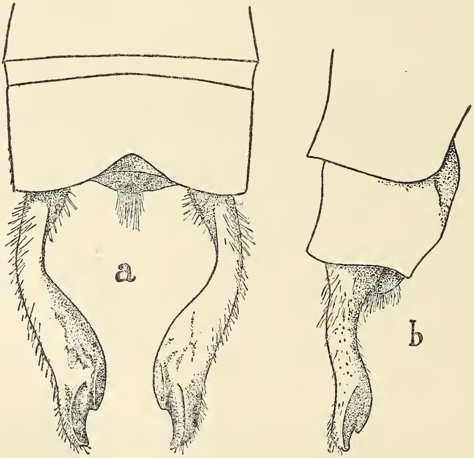

Fig. 2. Anal appendages of *Burmargiolestes melanothorax*. (Selys).
a. Dorsal view. *b*. Profile view.

large race of *R. mima* Karsch, the distribution of this species now extending from Borneo to Burma. Lastly *Mesopodagrion*, as represented by *tibetana* Macl., still remains a monotypic genus, confined, so far as known, to Thibet and Southeast China.

Genus BURMARGIOLESTES Kennedy (1925).

Burmargiolestes Kennedy, Bull. Mus. Comp. Zool. Havard, lxvii, No. 7. p. 296. Pl. fig. 6. (1925).

Wings long and narrow, petiolated nearly to level of distal end of discoidal cell and far distad of *Ac*; node situated at less than one-third the distance from base of wing to pterostigma; *Ac* situated almost opposite the basal antenodal nervure; *Ab* vestigial, only a trace of its distal end present; discoidal cell acute at distal end, its costal side about two-thirds the length of postcostal, these two sides diverging slightly and the outer side oblique; *IR2* arising about 3 cells distad of the origin of *R3*; *R3* arising slightly nearer the node than pterostigma; *IR3* arising 1 cell distad of the subnode; *R4+5* arising at the subnode; *MA* and *IA* pectinate. (This pectination being an expression of intercalated sectors between *R4+5* and *MA*, and *Cu2* and *IA*); intercalated sectors also present between *IR2* and *R3* and between *IR3* and *R4+5* at apical ends of wings; only a single row of cells between *IA* and hinder border of wings; pterostigma elongate, at least twice as long as broad, slightly dilated at the middle, both inner and outer ends oblique, unbraced, covering less than 2 cells.

Head narrow; epistome rather prominent. Prothorax with posterior lobe subbilobate; thorax robust; legs rather short, tibiæ not dilated, claw-hooks situated near end of claws. Abdomen long and slender, slightly dilated at base and anal ends. Superior anal appendages nearly twice the length of segment 10, forcipate; inferior appendages vestigial. Genitalia: hamules broad, subquadrate plates; penis broad at apex and slightly notched, curling up over the stem, its branches embracing that structure and spiral-like at the ends; lobe of penis flask-shaped, tumid. Vulvar scale robust, extending slightly beyond end of abdomen. Genotype—*B. melanothorax* (Selys).

Distribution.—South Asia and the eastern Himalayan tracts.

Burmargiolestes melanothorax (Selys)

Argiolestes melanothorax Selys, Bull. Acad. Belg. (2) xiv. p. 38 (1862); Id. Mém. Cour. xxxviii. p. 80 (1880); Id. Ann. Mus. Civ. Genov. series 2. x. p. 500 (1891); Laid. Rec. Ind. Mus. vol. xiii, pp. 323-325 (1917); Kirby, Cat. Odon. p. 125 (1890).

Burmargiolestes melanothorax Kennedy, Bull. Mus. Comp. Havard, ixvii, No. 7. p. 296, Pl. fig. 6 (1925).

Male. Abdomen 40 mm. Hindwing 28 mm.

Head: labium brown; labrum pale blue; bases of mandibles and genae black; epistome, frons and basal joints of antennæ pale blue; vertex and occiput black; eyes olivaceous brown.

Prothorax black with a broad subdorsal pale brown fascia on each side. Thorax glossy black, the upper ends of humeral and lateral sutures pale yellowish brown.

Wings hyaline; pterostigma dark reddish brown to almost black; 23 postnodal nervures to forewings, 21 in the hind.

Legs yellow, the tarsi and spines ferruginous, the distal ends of femora with a diffuse spot of dark brown on the extensor surface.

Abdomen glossy black or blackish brown in subteneral specimens, segments 3 to 6 with an obscure yellowish spot or annule near the base. Anal appendages blackish brown; superiors twice the length of segment 10, forcipate, slightly tumid at base, then subcylindrical and finally compressed at the apex where they are dilated and broadly notched and hollowed out on the inner surface, and present a flattened facet just proximal to the notch; outer borders finely spined, broadly sinuous; inner border of base minutely tuberculate and spined. Inferiors not visible from above, rounded, vestigial plates.

Female. Abdomen 34 mm. Hindwing 29 mm.

Very similar to the male but of more robust and shorter build. Differs as follows,—labium brownish black; black of vertex encroaches on frons which has two punctate black points ; eyes darker brown ; abdomen with sides paler and the dorsum of segments 8 and 9 yellowish brown ; segment 10 pruinosed white in adults ; anal appendages conical, pointed, as long as segment 10 ; vulvar scales brown, robust, minutely spined below.

Wings palely suffused with brown in adults especially at apices which may be quite dark brown along extreme borders ; pterostigma shorter and broader, often imperfectly braced, covering 2 to 2½ cells ; 29 postnodal nervures in forewings, 21 in the hind ; *Ac*, especially in the forewings, often slightly proximad to the level of the basal antenodal nervure.

Distribution. Upper Burma, Sikkim and Assam. The species from Siam and Tonkin appears to be quite distinct. The discoidal cell in this species is much shorter than in typical *Argiolestes*, the proportion of its costal and subcostal sides is quite different, the nervure *Ac* lies much more basad, whilst the origins of *IR3* and *R4+5* differ entirely from what is found in that genus ; important differences are also found in the genitalia.

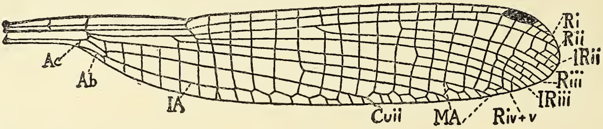

FIG. 3. Forewing of *Rhinagrion mima* (Karsch.)

Genus RHINAGRION Calvert (1913).

Amphilestes Selys, Bull. Acad. Belg. (2) xiv. p. 42 (1867) ; Id. Mém. Cour. xxxviii, p. 92 (1886). *nom. preoc.* ; Kirby, Cat. Odon. p. 126 (1890).

Rhinagrion Calv. *nov. nom.* (*Amphilestes*) Proc. Acad. Phil, 65, p. 258. (1913).

Wings long and narrow, petiolated to the level of *Ac* ; node situated at slightly less than one-third the distance from base to pterostigma ; *Ac* situated nearly opposite the level of the distal antenodal nervure, slightly proximad to that structure ; *Ab* complete, meeting *Ac* at border of wing ; discoidal cell subacute at apex, its costal side two-thirds to three-quarters the length of subcostal, these sides diverging distad, outer side rather oblique ; *IR2* arising 4 to 5 cells distad of the origin of *R3* or halfway between the origin of latter and the pterostigma ; *R3* arising in the forewing 5 to 6 cells distad of the node and much nearer latter than pterostigma ; *IR3* arising at the subnode ; *R4+5* arising well before level of subnode ; *MA* and *Cu2* simple ; *IA* zigzagged at its distal half only ; no intercalated sectors except short ones at the apices of wings ; pterostigma elongate, more than twice as long as broad, slightly dilated at its middle, inner and outer ends oblique, only occasionally braced, covering 2 cells.

Head moderately narrow ; epistome not prominent ; occiput deeply concave. Prothorax with a simple rounded and arched posterior lobe ; thorax robust, furnished, in the female, with prominent hooks at the anterior ends of humeral sutures for copulating with the male.

Legs rather short, robust, tibiæ slim, claw-hooks near ends of claws, femoral and tibial spines short, robust, not very numerous. Abdomen long, cylindrical, moderately robust especially in the female, dilated at base and gradually so at anal end. Anal appendages forcipate, nearly twice the length of segment 10, inferiors vestigial. Genitalia : hamules moderately broad quadrate plates, pointed posteriorly ; penis narrow at apex, curling over stem of organ, its branches strongly curled to embrace the stem and shaped like the horns of an ox as seen from the dorsum ; lobe small, inconspicuous, pyriform.

Vulvar scale robust, projecting well beyond end of abdomen, stylets of great length. Genotype,—*R. macrocephala* (Selys)

Distribution. Burma, Borneo, Malaysia and Sumatra.

Rhinagrion mima Karsch

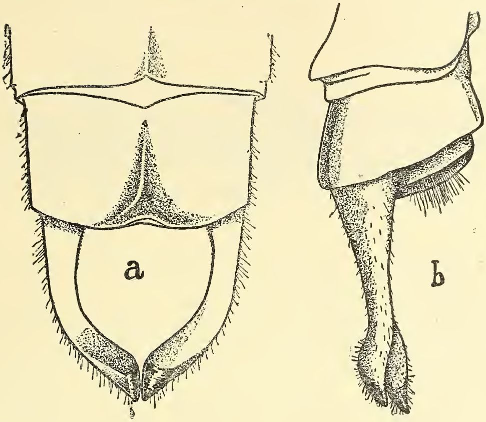

FIG. 4. Anal appendages of *Rhinagrion mima* (Karsch).
a. Dorsal view. *b.* Profile view.

Amphilestes mima Karsch, Ent. Nachr. xvii, pp. 242, 243, (1891) ; Kruger, Stett. Ent. Zeit. p. 100 (1898) ; Laidlaw, Proc. Zool. Soc. Lond. p. 382, 2nd Dec. (1902).
Rhinagrion tibetana Fras. (= *mima*) Rec. Ind. Mus. vol. xxvi (1926).

Male. Abdomen 36 mm. Hindwing 27 mm.

Head black marked with bright ochre or citron yellow ; labium pale straw yellow ; labrum bright ochreous broadly bordered with glossy black ; epistome similar ; bases of mandibles and genae bright yellow ; frons and vertex bright ochreous with a broad median uneven stripe of matt black ; occiput, antennæ and the seat of the latter as well as a small point in front of them matt black ; eyes olivaceous bordered behind by a narrow black band and this latter by another ochreous band equally wide.

Prothorax with an anterior collar, the whole of posterior lobe and a large oval spot on each side bright ochreous, middle lobe and dorsum black.

Thorax velvety black marked with bright yellow or ochreous as follows,—a broad antehumeral stripe not extending to upper and lower part of dorsum, gently curved with the concave sides of the stripes facing one another, the upper halves of the antealar sinus. Laterally bright yellow with a moderately broad median black stripe.

Legs bright ochreous, the flexor surfaces paler yellow, the spines, tarsi, flexor surfaces of tibiæ and the extensor surfaces of the two anterior pairs of femora black.

Wings hyaline, palely enfumed in old adults ; pterostigma black, covering one and a half to two cells ; 13 to 14 postnodal nervures in forewings, 12 in the hind.

Abdomen ferruginous ringed subapicad on segments 2 to 6 with bright ochreous followed by moderately broad black apical rings, segment one paler yellow or greenish-yellow with a narrow apical bordering of black laterally and a finely delineated dorsal marking shaped like the handle of a dagger ; segment 10 with a broad dorsal marking shaped like a cross ; ventral surfaces and ventro-lateral borders of segments 8 to 10 black.

Anal appendages black, the superiors with the apical third bright ferruginous except the extreme apex which is black. Superiors forcipate, curving medialwards to meet at apices, apical halves compressed, the inner surface shallowly concave, apices bevelled within and ending in an acute point. Inferiors rounded, very short, vestigial, not visible from above.

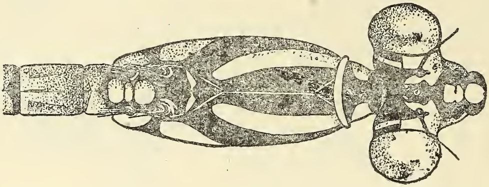

FIG. 5. Markings of head and thorax of *Rhinagrion mima* (Karsch.)

Female. Abdomen 33 mm. Hindwing 29 mm.

Very similar to the male but more robust, differs as follows,—bright markings of head, prothorax and thorax citron yellow, those on the former more restricted, a large irregular spot on the vertex being isolated by the black ; occiput with a narrow dark ferruginous border behind.

Thorax with the black on anterior border of metepimeron reduced to an irregular dark blackish brown stripe incomplete above and below. The anterior part of mid dorsal carina bifurcating to enclose a small triangular space, on either side of which is a large laterally compressed spine ending in a finely pointed hook, the outer part of the spine continued as a shell-like plaque overhanging the posterior lobe of prothorax or sometimes hidden partly by the latter.

Abdomen with segment 1 greenish yellow, the subapical annules on segments 2 to 6 brighter yellow and very conspicuous between the apical black annules and ferruginous of dorsum. On segments 3 to 7 the apical black is continued basad laterally, but slightly so on 3, but as far as the base on segments 6 and 7 on which segments the black also passes basad on the middorsum so as to enclose a spot of the ground colour ; segment 8 black, the middorsum finely, a subapical, subdorsal spot and the ventral border broadly ochreous ; segments 9 and 10 entirely black.

Anal appendages black, short, conical. Vulvar scales and stylets black. Legs with the extensor surfaces of all femora ochreous or ferruginous. Wings with 15 postnodal nervures in the fore, 14 in the hind.

Distribution.—South Shan States, Maymyo, Upper Burma, Sumatra and Malay Peninsula.

A number of both sexes taken by Col. F. Wall, I.M.S., along the borders of a small stream. The species which appears to be locally common, is most closely allied to *R. borneensis* Selys. Col. Wall's specimens which I incorrectly placed as *tibetana* have since been determined as *mima* by a comparison which I have been able to make with specimens in the British Museum. They are considerably larger than type and the markings are more yellow or ochreous than greenish-yellow.

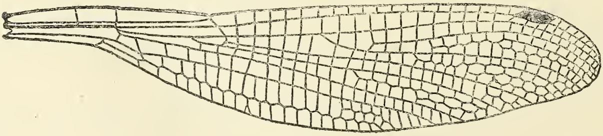

FIG. 6. Forewing of *Mesopodagrion tibetana* (Macl.)

Genus Mesopodagrion Maclachlan (1896).

Mesopodagrion Macl. Ann. Mag. Nat. Hist. Ser. 6. vol. xvii, May (1896).

Wings long and narrow, but moderately dilated about the middle area, petiolated to a little proximad of *Ac*; node situated at a little more than one-third the distance from the base of wing to pterostigma; *Ac* situated at a level slightly nearer the distal antenodal nervure; *Ab* complete, extending a little proximad of *Ac*; discoidal cell more acute than in *Rhinagrion*, its costal border rather less than two-thirds the length of subcostal, outer border very oblique, costal and subcostal sides diverging slightly; *IR2* arising about 3 cells distad of the origin of *R3* and about midway between the node and pterostigma; *R3* arising 6 cells distad of the node in forewing and much nearer node than pterostigma; *IR3* arising at the subnode; *R4*+5 arising well before subnode; *MA* and *Cu2* simple; *1A* zigzagged from its origin; 2 rows of cells between *Cu2* and *1A* near their terminations; intercalated sectors between *IR2* and *R3*, between *R3* and *IR3* and between *R4+5* and *MA*; pterostigma elongate, dilated at middle, oblique at outer and inner ends, well braced, covering about 3 cells.

Head moderately narrow; labium deeply cleft, lobes distant, subacute at apex. 2nd joint of antennæ rather longer than the first; epistome not prominent; occiput concave. Prothorax with posterior lobe simple, rounded, arched; thorax robust. Legs robust, rather short, spines of moderate length, not numerous, tibiæ slim, claw-hooks situated at extreme ends of claws. Abdomen robust, cylindrical, moderately short as compared to species of Rhinagrion, dilated somewhat at base and anal end. Anal superior appendages not twice the length of segment 10, forcipate, tapering, acute at apices; inferiors rounded, vestigial. Genitalia: lamina arched; hamules quadrate plates pointed posteriorly; penis narrow at apex but squared and curling strongly over body of organ, its branches embracing the stem and making a complete curl like a ram's horn; lobe small, pyriform, grooved longitudinally. Vulvar scales robust, strongly curved, projecting well beyond end of abdomen. Anal appendages of female conical, acuminate, as long as segment 10. Genotype,—*Mesopodogrion tibetana*. Macl.

Distribution: Thibet and S. W. China.

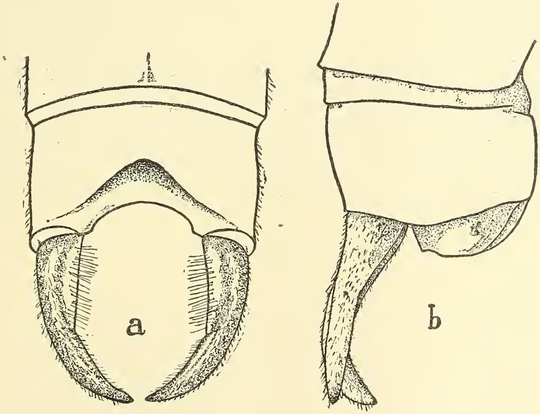

Fig. 7. Anal appendages of *Mesopodagrion tibetana* Macl.

a. Dorsal view. *b*. Profile view.

Mesopodagrion tibetana Macl.

Mesopodagrion tibetana Maclachlan, Ann. Mag. Nat. Hist. Ser. 6. vol. xvii. (1896).

Rhinagrion tibetana Fras. Rec. Ind. Mus. = *Rhinagrion mima* Karsch.

Male. Abdomen 33 mm. Hindwing 30 mm.

Head: labium brownish yellow; labrum, bases of mandibles and genae greenish yellow; vertex and occiput matt black with a short oblique line on the outer side of each ocellus, a short line on the posterior border of occiput and a large spot behind each eye yellow.

Prothorax black with a broad greenish-yellow stripe on each side continuous with a similarly coloured antehumeral stripe on thorax.

Thorax black on dorsum, yellow on the sides; dorsum marked with a pair of slightly curved antehumeral greenish-yellow stripes, the concavity of the stripe facing inwards. Laterally a moderately broad oblique black stripe broadening anteriorly.

Legs black, coxæ and trochanters with yellow spots.

Wings hyaline, palely enfumed and faintly tinted at the bases, pterostigma dark brown to blackish framed in black; 21 postnodal nervures in forewings, 20 in the hind.

Abdomen glossy black, basal segments clothed with long black hairs, segment 1 broadly yellow at the sides, segment 2 with a pair of parallel yellow stripes along the sides, segments 3 and 4, and in teneral specimens, segments 3 to 7, wiih a large baso-lateral spot which is confluent with a rather broad lateral greenish-yellow or yellow stripe extending from base nearly to apex but falling short of latter in adult specimens on segments 4 to 7; segments 9 and 10 black, the latter with a large lateral yellow spot.

Anal appendages black: superiors forcipate, rather longer than segment 10, subcylindrical at base but compressed nearer apex which is acuminate, whilst on the inner side, near the middle of appendages is a false joint or sulcus, at which point the appendage is slightly but distinctly angulated inwards. Inferiors rounded, vestigial, not visible from above. Genitalia as for genus.

Female. Abdomen 35 mm. Hindwing 34 mm.

Closely similar to the male but the markings more greenish-yellow, and the spot behind the eyes absent or obsolete. The markings on the abdomen similar to those on teneral males, the stripes being continued on to the 3rd and 4th segments, and the basal spots on to the 7th; segment 9 with a very large lateral yellow spot whilst the 10th is largely yellow on the sides.

Anal appendages as long as segment 10, slightly curved laterally, acuminate, pointed, yellowish at base and separated by a large conical structure as viewed from above. Vulvar scales black, strongly curved. Wings faintly enfumed; pterostigma as for male (yellowish white in the allotype which however is slightly teneral); 21 postnodal nervures in forewings, 19 in the hind.

Distribution: Thibet and south-east China. The type and allotype, in the Maclachlan collection, are from Moupin and Siao-Lon respectively. Recently Mr. Kenneth Morton has received several more specimens from the same district which I have been able to compare with the types. The markings in the latter are definitely apple-green but, so far as the male is concerned, may be blue in the living insect.

(*To be continued.*)

THE FISH SUPPLY OF THE WEST COAST OF INDIA

BY

SIR REGINALD SPENCE, KT. M.L.C., F.Z.S. AND S. H. PRATER
C.M.Z.S., M.L.C.

(*With three Plates*)

In No. 2 of Volume xxix, published as long ago as August 1923, the then editors, the writers of the present paper, published an article on the Fish Supply of our Western Coast based on the report of the work of the Steam Trawler *William Carrick* and promised ' in the next number of the Journal ' to continue with a description of the principal edible fish and to comment on Mr. Hefford's remarks on the possibility of achieving commercial success with small boats and deep sea seining. The editors also proposed to make a reference to the needs of a market on shore.

They also stated that they would be pleased to include (if possible) any comments and suggestions members of the Society might have to make on what they had written. This statement is now their ' Saving Clause' and is the only excuse they have to offer for making No. 2 of volume xxxiv published in 1930 take the place of ' the next number ' which was published in December 1923.

An old editor of the *Journal* did, it is true, write out a few months ago and enquire when his successors were going to get a move on. No other member made any comments, but Mr. F. V. Evans, one of our Vice-Patrons, helped us in a very practical manner. He provided us—and still provides us—with the financial means necessary to enable us to carry out our promise to issue illustrations of principal edible fish as, thanks to his generosity, we have now in the Prince of Wales' Museum a fine series of casts of the edible fishes of the Western Coast of India and are able to illustrate the second part of our paper. It is due to the above mentioned causes rather than to the pricking of an uneasy conscience that we carry on the story of the *William Carrick* and say something about the condition of the Fishing Industry in Bombay in 1930.

THE ' WAGLI ' (SKATES OR RAYS)

In chapter V of his report Mr. Hefford gives information as to the chief kinds of Fish caught. We may dispose, first of all, of the fish or fishes which were obtained in largest numbers. These were the ' Wagli ' (Skates and Rays) and of these Mr. Hefford writes :—

' For total weight caught by the trawler, the fish classed under this name come easily first compared with any other kind taken, constituting 24 per cent of our total catches (by Weight). There are several different genera and species known under the same general vernacular name of *Wagli* and called rays or skates by English-speaking people all over the world. They all belong to the group of cartilaginous skeletoned fish known to Science as the *Batoidei* and all are characterized by a flattened body with a rhomboidal or kite-shaped outline, sometimes more or less rounded, and a slender elongated tail. The family *Trygonidæ* is very abundantly represented by several different species in Bombay waters (Plate I). This is the family of Sting-rays or Whip-rays, so called because of the slender whip-like tail, armed with one or more long saw-edged spines, with which the fish is able to inflict painful inflammatory wounds. The flesh of these fish is practically indistinguishable in flavour from that of the European *Raidæ* (Skates and Rays) which fish, though formerly not much esteemed in England, nowadays commands a good market and is recognized as an excellent food. It is, as a matter of fact, much more nutritious and digestible than many other sorts of fish which command higher prices. The same may be said with greater emphasis about the Bombay *Wagli* in comparison with other sorts of fish obtainable here. Apparently its somewhat grotesque appearance and its apparently scaleless skin are drawbacks which at present limit its consumption to the poorer and lower classes of the fish-eating people of Bombay.'

'Besides the above mentioned family of *Trygonidæ*, represented in our catches by *Trygon walga*, *T. uarnak*, *T. zugei*, *T. sephen* and *Pteroplatea micrura*, and possibly others, other fishes of the *Wagli*, kind which were commonly taken were *Ætobatis narinari*, and species (undetermined) of *Myliobatis*, *Dicerobatis*, and *Rhinoptera*.'

As an indication of the distribution of Skates and Rays in Indian coastal waters it is interesting to compare the catches made by the Trawler '*Lady Goschen*' on the Malabar Coast and the '*Golden Crown*' in the Bay of Bengal. On the Malabar Coast the commonest skates were *Trygon sephen* and *T. khulii*. One large example of the former taken by the Trawler scaled 1,000 lbs. The operations of the *Goldren Crown* show that in the muddy waters off the Sunderbans the most characteristic species were *T. uarnak* and *T. bleekeri*. They included 23 per cent. of the catches. One huge example of *T. uarnak* scaled 1,360 lbs. *Rhynchobatus djeddensis* was most plentiful off Chittagong, while further south on the Ganjam coast *T. kuhlii* and *T. zugei* were found to be the most common. Off the coast of Akyab the commonest species, according to Captain Lloyd, are *T. uarnak* and *T. walga*.

Skates are plentiful in the Bombay Market during the cold weather. Their abundance during the season is ascribed to the fact that they come close to the shore to produce their young. This is believed to be in accordance with the habits of most shore fishes which migrate to deeper waters as they grow larger. The Trawler, working further at sea than the local fishing boats are accustomed to, brought back, in the case of many species, larger examples than customarily sold in the market.

Various species of skates (*Trygon*, *Rhynchobatus*, etc.) are brought to the Bombay Market between October and May. They average from 1–50 lbs. and sell at Rs. 2 to Rs. 10 each according to size—the demand depends on other species of fish first available.

The *William Carrick's* estimated total catch of *wagli* was about 50,000 lbs., averaging approximately 30 lbs. for every hour of trawling, 21,724 lbs. of *wagli*, separately marketed as such, realized altogether Rs. 311, an average price of 2·7 pies per lb. The highest price per lb. was 8 pies (in January) and the lowest, half a pie per lb. (in November).

The statistics supplied by the Madras Fisheries Department for the year 1926–27, dealing with fisheries over a portion of the West Coast comprising the districts of South Kanara and Malabar, enumerate 42 marketable fishes arranged according to value and quantities obtained :—' Skates and Rays ' figure 13th on the list. The total catch during the year amounted to 12,856 maunds, approximately 1,028,480 lbs. valued at Rs. 36,380, which works out at roughly 7 pies per pound. In a statistical account of the Fish supply of Madras city, 52 food fishes are given in the order of their value. ' Skates ' come 15th on the list and realize on an average retail price of 3 as. 6 p. per lb.[1] The report says, ' Rays are highly esteemed as food by the masses.' The statistics above quoted show that this class of fish is better appreciated in Southern and South-Western India than on the Bombay coast. On the Burmese coast at Akyab *Trygon walga* is a favourite food fish of the Arakanese, another skate equally esteemed is *Pteroplatea micrura*.

9, 946 lbs. of these fish, taken by the ' *William Carrick* ', were supplied gratis to the British Military forces in Bombay and, it is understood, were a very much appreciated ration.

It is rather curious, in view of the low estimation the flesh of these fish is held in Bombay, that the announcement in the windows of Fried-Fish shops in towns on the east coast of England ' Skates available to-day ' should at once lead to an increase in the Fish Shop's Trade. It is also to be regretted that in view of the need of fertilizers on the land so much of the catch of *wagli* had to be emptied back into the sea as it did not pay the cost of handling and transit on shore.

THE GHOL (or GOAL) FISH

The fish which came second in point of quantity (24,298 lbs. landed) but first in point of total value among all the kinds caught by the Trawler is the fish Mr. Hefford calls the ' *Goal* ', but the proper spelling of which is probably ' Ghol '. In the market this fish is sold to us under the general name of Salmon, but the name Salmon is also applied to various species of *Polynemus*.

He writes :—

' It is a fish well known in Bombay markets, where it fetches a good price on account of its firm white flesh and good size. Its commercial position here may perhaps be compared with that of the cod in the fish markets of Europe or Northern America. It belongs to the genus *Sciæna* of the family *Sciænidæ* to which belong numerous species distributed throughout the warmer seas of the world. Sixteen different species of *Sciæna* are recorded by Day as occurring in India. Many of these are too small when full grown to possess appreciable commercial value. The large goal which were commonly taken in the trawl off Bombay, appear almost without exception to belong to the species *Sciæna diacanthus*. The weights of individual fish lay for the most part between 10 and 25 lbs., the average being about 15 lbs. Our best catch of goal was made on February 21, 1922 off Karachi in 14 fathoms of water when 75 fish having a total weight of 1,149 lbs. (after being gutted) were taken in a haul of 5½ hours duration. The species is known to occur in great abundance near the coast in the neighbourhood of Karachi in the months of April and May when it is the object of a great local fishery.'

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[1] It should be noted that the rates quoted for the Bombay and Madras markets are retail prices.

On the south coast, off Calicut, the commonest species taken by the '*Lady Goschen*' was *Sciæna bleekeri*. The largest catches were made between November and April. In the northern waters of the Bay of Bengal, as shown by the catches made by the *Golden Crown*, the commonest species was *S. vogleri*. In Madras city the species of *Sciæna* generally taken are *S. belangeri*, *S. albida*, *S. miles*, *S. maculata*, and *S. aneus*. Specimens of this genus in the Society's collections obtained from the Bombay market are :— *S. diacanthus*, *S. sina*, *S. maculata*, *S. ossa*, *S. glaucus* and *S. aneus*.

Despite Mr. Hefford's identification of his main catch of *Sciæna* as *S. diacanthus*, the two commonest species in the Bombay market are *Sciæna sina* and *S. glaucus*. Both these species attain a large size, 100 lbs. in weight and upto 6 feet in length. *S. sina* is included among the migratory fishes which visit our creeks and estuaries. The season for Ghol along the Bombay coast is from October to May. The fish are cut up and sold piece-meal, the price varying from 8 annas to 10 annas per lb. As regards prices obtained, Mr. Hefford writes :—

'Large *goal* are of value not only for the sake of the fish itself but also on account of the Swim bladder (the 'maw', 'pok' or 'sound') from which isinglass is obtained.'

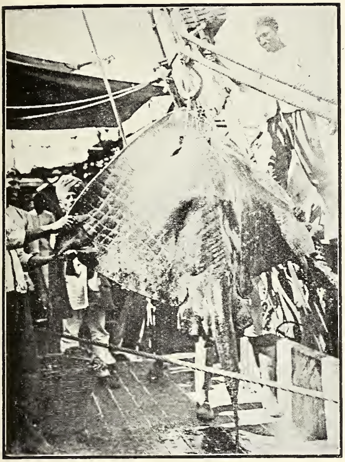
'The highest price per lb. realized from our sales was 11 annas. The lowest was 11 pies. The average for all sales was 4 annas 2·5 pies per lb.'

'An idea of the appearance of the fish may be obtained from the photograph.' (Plate I.)

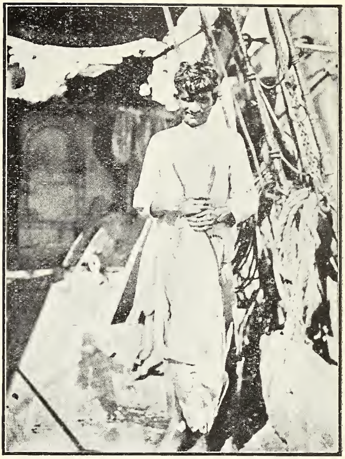
On the Malabar coast the *Sciænidæ* range 9th as regards quantity and 10th in value. Between 1925 and 1926, 34,821 maunds were taken representing a total value of Rs. 57,227. In Madras city, *Sciænidæ* rank 5th in importance as regards weight and value. The total catch for the year 1921–22 amounted to 147,152 lbs. The price is lower than in Bombay, averaging 2 anns 9 pies per lb.

THE POMFRET

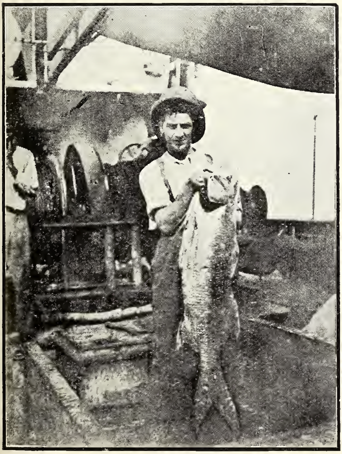
As regards the best known and most popular fish in Bombay, the *Pomfret*, Mr. Hefford thinks that possibly its relative abundance in the cold weather season to some extent detracts from its esteem. Mr. Hefford need not worry. The pomfret is missed so much in the rainy season that each cold weather it seems to gain in



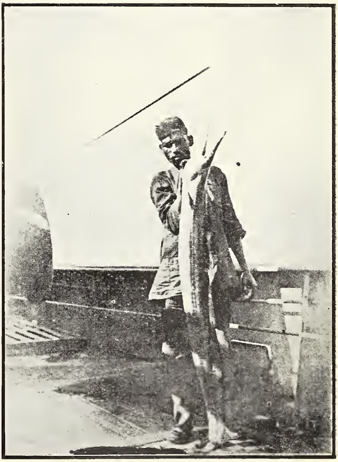
Wagli (*Trygon microps*).



Goal (*Sciæna diacanthus*).

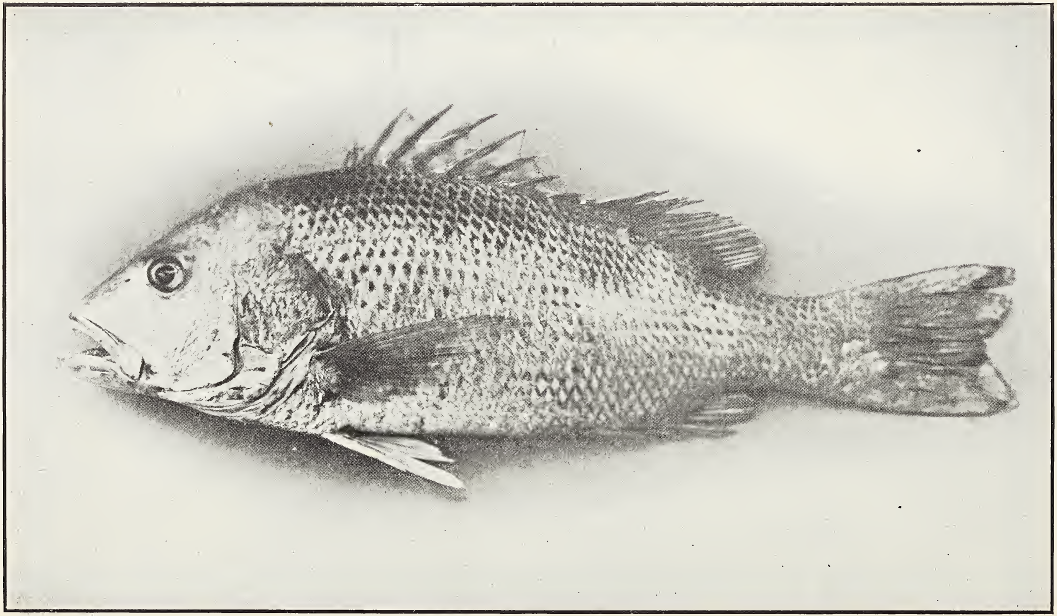


Ravas (*Polynemus indicus*).



Wam (*Muræenesox talabonoides*).

(*Reproduced from the Report on the Work of the Steam Trawler ' William Carrick '.*)



Tambusa (*Lutianus johnii*).
(*Reproduced from the Report on the work of the Steam Trawler ' William Carrick '*).

appreciation and certainly when it is not with us nothing is said to its discredit but decidedly the reverse. Mr. Hefford writes :—

'Europeans commonly refer to it as a 'flat fish' and erroneously class it with the *plaice* and *dab* of British waters but it is not a flat fish in the same sense as these (which have both their eyes and all their colouring on one side of the body only and have the habit of lying on the sand at the bottom of the sea where they find their food, and very rarely, if ever, leave the lowermost layers of the water). The pomfret is indeed flattened in shape but it has an eye on each side of its head and is coloured similarly on both sides of its body. It does not appear habitually to swim near the bottom or our trawl hauls would have contained more pomfret than they did. Occasionally small shoals of pomfret were observed from the trawler swimming quite close to the surface of the sea.'

'The pomfret is scientifically known as *Stromateus cinereus*.[1] It is also commonly called the 'white pomfret' to distinguish it from the 'black pomfret' (*Stromateus niger*) which is quite common in these waters but is apparently very much less abundant than the former. In the 'Fishes' volume of the '*Fauna of India*' series a third species (*Stromateus sinensis*) is given the English name of 'white pomfret', and the common pomfret is termed *silver pomfret* when immature and *grey promfret* when adult. *Stromateus sinensis* however is so relatively little met with among the Bombay market fish that it calls for no further remark here.'

Since *S. cinereus* (Marathi, *Saranga*) is so universally known as *the* pomfret, it is only necessary to distinguish it from Day's *S. niger* (Marathi, *Halwa*)—the *black* pomfret, and it seems preferable to adopt the fauna nomenclature here. It may be mentioned that *S. cinereus* in the fresh condition is characterized by the silvery lustre of the scales on the sides of its body which, while more conspicuous in the young are by no means lacking in the big fish. We therefore call *S. cinereus*—the silver, and *S. sinensis*—the white pomfret.

While *S. sinensis* is rare in Bombay, it is not uncommon on the Malabar coast during the South-west monsoon. It is the commonest pomfret in the Madras market and is quite plentiful on the Arakan and Bengal Coast. Dr. Jerdon describes it as the best flavoured of the three pomfrets Mr. Hefford writes :—

'The total quantity of pomfrets caught by the trawler was 6,876 lbs. of which 5,939 lbs. sold in Bombay market realized a total sum of Rs. 2,618. Our biggest single haul was 490 lbs. in a 3½ hours' tow made on October 6, 1921, off Bombay in 24 to 25 fathoms (Voyage *XVIII*, Haul 3). The prices realized by our sales ranged from Rs. 1–3–7 per lb. in July (during the monsoon when loca boats are not at sea) to 2 annas per lb. in November and December, a time when there is a plentiful supply available in Bombay. The average for all pomfret marketed was 6 annas 11·9 pies.'

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[1] These are the scientific names in Day's works on Indian Fishes which are the ichthyological books of reference most likely to be easily accessible to the reader. It may, however, be mentioned that the present-day authorities do not recognize these generic names. Nor is the black pomfret regarded as a true pomfret at all. The similarity between the two species is, as a matter of fact, quite superficial.

Between June and September pomfrets are very scarce in the Bombay market, The season for pomfret commences about October, the largest quantities are marketed between November and February, the prices, in good seasons, then range from four to six annas for a pair of good, sizable fish. At the commencement of the hot weather the numbers decrease and prices range from Re. 1 to Rs. 1-8-0 a pair. The fish available are much smaller in size. A southward migration of pomfrets appears to take place between March and April when this species becomes plentiful on the South Kanara coast, while in July and August they are abundant further south on the Malabar coast. A similar southerly migration seems to take place on the East Coast of India. Dr. J. T. Jenkins, in his observation on the working of the '*Golden Crown*' in the Bay of Bengal, says that pomfrets were most abundant in the northern part of the Bay of Bengal during January and February when vast shoals were observed swimming liesurely past the trawler; while in Madras City the statistical report indicates that the fish is most plentiful between June and November. A curious feature about the catches by the '*Golden Crown*' was that the largest hauls were made by day-light. Between February 9 and 15, 20 hauls were made, 10 by day and 10 by night. The total weight secured was 2,773 lbs. of which only 65 lbs. were taken at night. Pomfrets in the Bombay market were found 'in roe' during September, and young fish measuring a few inches in length are taken in plenty during November and December. The young of *S. sinensis* are observed in plenty along the coast and estuaries of Bengal during March.

THE 'KAREL'

The next fish in importance in Mr. Hefford's list is the 'Karel.' He writes:—

'This fish is not well-known in Bombay, but it may undoubtedly be classed among the 'prime' qualities. It is a perch-like fish corresponding with the species described and figured by Day as *Pristipoma maculatum*. The name *karel* is that used by the Ratnagiri deck hands of the trawler, but it appears to be similarly used in Bombay also, though at least some people apply the name *Karkara* to the same fish. Day (*Fauna of India*—Fishes I, p. 510) gives *Karkutla* as the Marathi name of the species. Dr. Jenkins in his report on the working of the Steam Trawler '*Golden Crown*' includes it with one or more other perch-like forms under the name Bekti (used as a class name—the bekti of Bengal being strictly applicable to the species *Lates calcarifer* which is the *Khajura* of Bombay). The Karel is a bright handsome fish with a dark greenish purple back and silvery sides. On those caught near Bombay the silvery lustre is associated with yellow pigment which gives the fish a pale golden appearance, but on the Sind grounds the fish are more purely silvery. The younger fish are characterized by the presence of dark bars on the sides which disappear with age. Its flesh is firm and flaky and of good flavour. It soon became the favourite fish of the Europeans on the trawler and was eaten in preference to any other. If it became better known it would certainly find favour among the consumers of the best kinds of fish in Bombay and would command better prices than we made.'

Writing about this fish, Day remarks, ' It is fair as food, but not much esteemed.'

' The total weight of Karel caught by the trawler was 15,190 lbs. The total weight of large Karel marketed as such in Bombay was 8,411 lbs. which realized a total sum of Rs. 1,209. The price per lb. varied from seven pies in November to four annas in August. The average was 2 annas 3·6 pies per lb.'

' The largest Karel taken in the trawl was 25 inches long. The usual range of size of the fish marketed as Karel was from about 15 to about 22 inches. The corresponding range in weight is 2 lbs. to 6 lbs. Our largest take in a single haul was 807 lbs. (about 250 fish) in a haul of 3¾ hours' duration made on August the 29, 9 miles east by south from Kundari 15 to 16 fathoms.'

On the Madras coast *P. maculatum* is common between February and May. On the Malabar coast it does not appear to be abundant. The total catch for the year 1925–26 was only 421 maunds valued at Rs. 577.

THE ' BAHMIN '

Fourth in order of value among the fish landed by the trawler is the fish known to anglers as the *Bahmin* and to Bombay landladies and hotelkeepers as the Indian Salmon. The total landings of this fish were 3,254 lbs. and realized Rs. 1,215.

Mr. Hefford writes :—

' Three distinct species of the genus *Polynemus* (viz., *P. indicus*, *P. plebeius* and *P. tetradactylus*) are included in this class to all of which in the market and in the menus the English name of Salmon or Indian Salmon is applied. While possessing absolutely no resemblance to the salmon of northern waters, these fish have excellent eating qualities which are reflected in their market prices. I give the Marathi name *Ravas* as a sort of class name for market purposes, following in this respect the practice of the members of the Ratnagiri fishing community who were on the ' *William Carrick* '. The name ' Ravas ' is applied generally to all *Polynemus* species. The most abundant species taken by the trawl in our catches, *P. indicus*, which is also the most frequently seen in Bombay fish markets, is however commonly known in Bombay as *dara* (Plate I). The same name is often applied to the larger specimens of *P. tetradactylus*. There are several records from our earlier voyages in which the particular species is not shown, but from the records where the specific identity is clear, we obtain for *P. indicus* (dara) a total of 88 large fish of a total weight of 1,135 lbs. (average 13 lbs.). The heaviest individual fish recorded was 34 lbs. (total length 3′ 8″). The largest catch in a single haul was one of 17 fish weighing altogether 435 lbs. made in 3½ hours on January 30, 1922, 23 miles WNW from Kundari in 22 fathoms. There are records of 48 small-sized fish of this species with a total weight of 58½ lbs. and of 35 specimens of small size the weight of which was not separately taken.'

'*Polynemus plebeius*, which resembles *P. indicus* in having five of the free filament-like rays at the base of the breast fin which are characteristic of the family, but may be fairly readily distinguished from the latter species by the relatively greater thickness of the root of the tail (called by zoologists the caudal peduncle) and by the proportionately larger eye, was of less common occurrence in our catches and never of sufficiently large size to be of commercial importance. Day's works give no record of sizes for this species. Fifty-five specimens altogether were recorded, the largest being 11½ inches in length.'

This species was found to be common in the muddy waters of the coast of Arakan where good catches were made by the '*Golden Crown*.'

'The third species, *Polynemus tetradactylus*, differs from the above two in having only 4 free rays to the pectoral fin. It is a more shapely fish than the others and has the silvery sheen and the graceful body contour which call to mind comparison with the true salmon of the north. Our records of fish weighed contain altogether 83 of this species with a total weight of 331 lbs. 9 others are recorded but no weights given. Only one specimen of large size is definitely included among these records and that is one of 15¼ lbs. The best catch recorded is one of 40 fish weighing altogether 220 lbs. made on July 12, 1921, in 22–25 fathoms, 21 miles E.N.E. from Kundari, but there is some doubt as to whether the whole of this catch actually consisted of this one species of *Polynemus*.'

'The price realized varied from 13 annas 9 pies per lb. in December to 3 annas 6·3 pies in February. The average is 5 annas 11·9 pies per lb. The 'pok', 'maw' or Swim bladder of the ravas is thick-walled and rich in gelatine like that of the goal and is similarly of commercial value as a source of isinglass.'

The species of *Polynemus* obtained from the Bombay market in the Society's collection are *P. indicus*, *P. sextarius*, *P. heptadactylus*, *P. plebeius*, and *P. tetradactylus*.

Of these the largest is *P. tetradactylus*, the Bahmin, famous as a sporting fish, which is said to attain a length of 6′ and scales as much as 168 lbs. (Wallinger).

P. indicus grows to about 4′, and according to Day is rarely over 20 lbs as compared with Mr. Hefford's fish of 3′ 8″ weighing 34 lbs. *P. plebius* goes up to 53 lbs. (Wallinger). *P. heptadactylus* and *P. sextarius* are small fishes not much above 6″ to 8″ in length and about 2 lbs. in weight. *P. plebius* (Ravas), *P. tetradactylus* (The Bahmin or Dara which is the name Wallinger gives to the large Bahmin) and *P. tetraadactylus* (Shendwa) are listed among the migratory fish which visit our creeks and streams and rivers during the monsoon for spawning purposes. 'Ravas' are abundant at the mouth of the Tapti and its tributaries in May and June. Hundreds of maunds of fish are taken by the fishermen in our creeks before the monsoon and again in October.

P. paradiseus known on the Bengal side as the 'Mango Fish' similarly runs up the rivers of the East coast during the monsoon and the cold months. It commences to be taken in June.

THE 'WAM'

Mr. Hefford writes of the 'Wam':—

'This is the Marathi name for fish belonging to the genus *Murænesox* of which there are three species known in Indian seas (Plate I). Our catches consisted almost entirely of *M. talabonoides*. An occasional *M. cinereus* was observed, but we have no definite record of the third species, *M. talabon*. One distinguishes between them by the arrangement of their teeth; but observations of the dental characteristics of a live *wam* are very apt to be attended by a sudden and vicious display of their utility as a weapon of offence. In its tendency to snap like an angry dog the *wam* resembles the European conger to which it is also very similar in body form and in its edible qualities. The jaws of the wam, however, are longer and more slender than those of the conger. It appears to be associated with an entirely muddy bottom habitat, while on the other hand, the European conger is a frequenter of rocky ground. The flesh of the wam is somewhat tough when fresh, but it has better keeping qualities than the more tender fish. Its scales are so small and so embedded in the skin that they appear to be absent, which may detract from its market value. An idea of the appearance and size of the wam taken in the trawl may be obtained from the photograph.'

'All our wam were of large size varying in weight between 7 and 17 lbs., the majority being about 9 or 10 lbs. weight and about 5 feet long. The smaller sizes obviously escape through the meshes of the net. Altogether 16,337 lbs. of wam were landed for market, of which 14,703 lbs. were sold as such and realized Rs. 1,103. The highest price realized was 2 annas per lb. in June; the lowest 5 pies per lb. at the end of September and middle of November. The average price was 1 anna 2·4 pies per lb. The 'pok' of the wam is marketable as a source of isinglass.'

In Bombay and Madras, eels are abominated by the higher caste Hindus who regard them as Sea-serpents and they are rejected by Mohammedans because they are scaleless. Scaleless fish are forbidden to Mohammedans, Jews and were at one time to the British Navy. There used to be an old rule in the Navy that scaled fish were wholesome as food and that scaleless fish were not. This is not always the case, many fish with large scales are poisonous while scaleless fish, like some of our *Siluridæ* (Cat fishes), are wholesome and nourishing. It is interesting in this connection to note that the fresh blood of some of the eels of the genus *Muræna* is highly poisonous if injected into the blood of a mammal. Its venomous nature is due to the presence of ichthyotoxin which is compared to the toxablumen of vipers. The toxicity of the blood varies with the season and environment. A guinea pig injected with the serum of the blood of a common eel was dead in three minutes.

The following species are in the Society's collection and were obtained in the Bombay market. *Muræna tessalata*, *M. undulata* and

Murænesox telabonoides. The last species is plentiful between October and March. The weights range from 1 lb. to 151 lbs. :—

THE 'TAMBUSA'

Next in order Mr. Hefford places a fish with the Marathi name '*Tambusa*' (Plate II). He says :—

'The fish marketable under this name belong to the genus *Lutianus* of which there are many different species in Indian seas. In our hauls the species *Lutianus johnii* was predominant. It is a particularly handsome fish, rather like a robust-looking Karel in general shape and even more beautifully marked than that brilliant-fish. The Marathi names, Tambusa, Tambus or Tambre, were obviously suggested by its shiny and ruddy appearance. Its sides have a pale golden sheen and the upper half of the body is speckled with a rich brown colouring associated with red. The smaller fish are less richly coloured. The flesh is firm and of good flavour, not unlike that of Karel but perhaps still more like that of the big ravas (dara) or Indian Salmon. If properly known it would certainly be regarded as one of the 'prime' fishes of Bombay. The range of size usually lay between about 24 inches (8 lbs.) and 30 inches (12 lbs.) The largest observed was 33 inches long and weighed 17½ lbs.'

'The only other *Lutianus* species of which we caught any appreciable quantity was *L. annularis* which is entirely bright red in external colouring,[1] but as regards edible qualities not unlike the other. The usual sizes met with lay between 16 and 24 inches. The greatest length recorded was 26 inches. The Ratnagiri men on the trawler called it *Lalgon* (i.e., Red One), but I do not know how far this may be regarded as the distinctive name for the species. It was called tambusa for market purposes and in the trawling records 'Red Tambusa' to distinguish it from the other which we called 'Speckled Tambusa'. Altogether, 6,065 lbs. of tambusa were sold as such in Bombay and realized a total sum of Rs. 801. The trawler records show a total catch of 5,181 lbs. of the speckled and 1,840 lbs. of the red sort. The best single haul of the former was made on February 20, 1922, off Karachi in 14 to 7 fathoms (hauling 31 miles S.E ¾ E. from Cape Monze) when 70 fish weighing 719 lbs. were caught in 3½ hours. In the case of the red tambusa a haul of 3½ hours on November 11, 1921 in 23 fathoms off Diu Head (124 miles NW ½ W from Bombay) produced a catch of 179 fish weighing 992 lbs. It would thus appear that both species are more abundant to the north-west than in the vicinity of Bombay. The speckled species was found to be the more general in its distribution both as regards locality and season. Practically all our red tambusa were taken in the months of October and November.'

'The best price realized for speckled tambusa was 6 annas 3 pies per lb. (in October), the lowest was 11 pies (in November). On November 15, when 1,491 lbs.—practically all red tambusa—were marketed, an average of only 8 pies per lb. was realized. The average price from all sales of tambusa was 2 annas 0·6 pies per lb.'

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[1] The dark markings on the head and nape and at the base of the tail are inconspicuous on the freshly-caught fish.

Cherry-red tambusa frequent in the Bombay market are *Lutianus argentimaculatus*, *L. roseus* and *gibbus*. *Lutianus johnii* to which Mr. Hefford refers is listed as one of the migratory fish which visit the estuaries and creeks. Other species obtained in Bombay are *L. kasmira*, *L. lineolatus and L. rivulatus.*

THE 'SHINGALA'

Third in order of abundance in the trawler catches and generally distributed over the muddy grounds in the neighbourhood of Bombay, comes the '*Shingala*'. Of this fish it is recorded :—

'Well-known though not very highly esteemed in the Bombay fish-markets. They appear to be as abundant in the Bay of Bengal as they are this side. In the *Golden Crown* reports, they are termed 'gurnards', a name given by the Britsh crew of the Bengal Government trawler on account of their resemblance to the European fish of that name in having broad bony heads and a liberal armament of spikes. The British crew on the '*William Carrick*' called them 'Cat fish',[1] a name almost universally applied to the *Siluridæ*, the family to which these fish belong and which is represented by numerous species in the fresh waters and seas of the tropics in both hemispheres. Many different genera and species of cat fish are known in the larger rivers and lakes of India, the purely marine species being relatively few. From the commercial point of view, the marine genus *Arius* is the only one of appreciable importance and to this genus belong practically all the Shingala landed by the '*William Carrick*'. As to the species, there were two or three and possibly as many as half a dozen different ones among our catches but their precise differentiation was a tedious and difficult matter to which sufficient attention could not be paid on the trawler and therefore specific names cannot here be given with confidence.

'Our total catch of Shingala was over 16,000 lbs.—an average of almost 9½ lbs. for every hour of trawling. Our biggest catch in a single haul was 1,010 lbs. taken on August 24, 1921, 22 miles S.W ½ W. from Janjira in 23 to 11 fathoms in a 3½ hours' haul.'

'The largest-sized individual noted was 35 inches long and weighed 14 lbs. The usual range of size was from about 15 to about 24 inches (2 to 6 lbs).'

'The total sum realized by the sale of 12 maunds 321 lbs. of Shingala was Rs. 568, averaging 8·8 pies per lb. The highest price realized was 2·1 annas per lb. in August and September; the lowest was 2 pies in November.'

'This fish only appears to be eaten by the lower classes. Its scaleless skin, which rather easily rubs off, and its colour which is usually leaden grey and sometimes of a livid blue, are points which go against it as a market fish. The flesh too is somewhat soft though of perfectly good flavour when fresh. The swim-bladder or 'poks' yield isinglass'.

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[1] From the whisker-like appearance of the feelers or barbels arranged round the mouth.

Marine Cat fishes from the Bombay market in the Society's reference collection are *Plotosus arab*, *Rita buchanani* and *Arius sona*. There is also a plaster cast of *A. dussumieri*. On the Malabar coast *Siluridæ* (cat fishes) rank 6th in quantity of catches and 3rd in value. The total catch for the year 1925–26 amounted to 65,433 maunds equivalent to 5,234,640 lbs. valued at Rs. 2,68,089. Catches are made throughout the year, but the quantities increase between September and January. In Madras City cat fishes though not eaten by the richer classes enter largely into the dietary of the poor, the same applies to Bombay. The total weight of cat fish brought to Madras city in 1921–22 amounted to 73,123 lbs, valued at Rs. 10,646. The average price paid being 2 annas 4 pies per lb.

Cat fishes sold in the Bombay market range from 1 lb. to 121 lbs. Retail prices range from 4 annas per lb. in the full season to 5 or 6 annas per lb. in the off season.

THE 'DORI.'

Akin to the popular *Goal* and next on the list comes the '*Dori*'. The report says:—

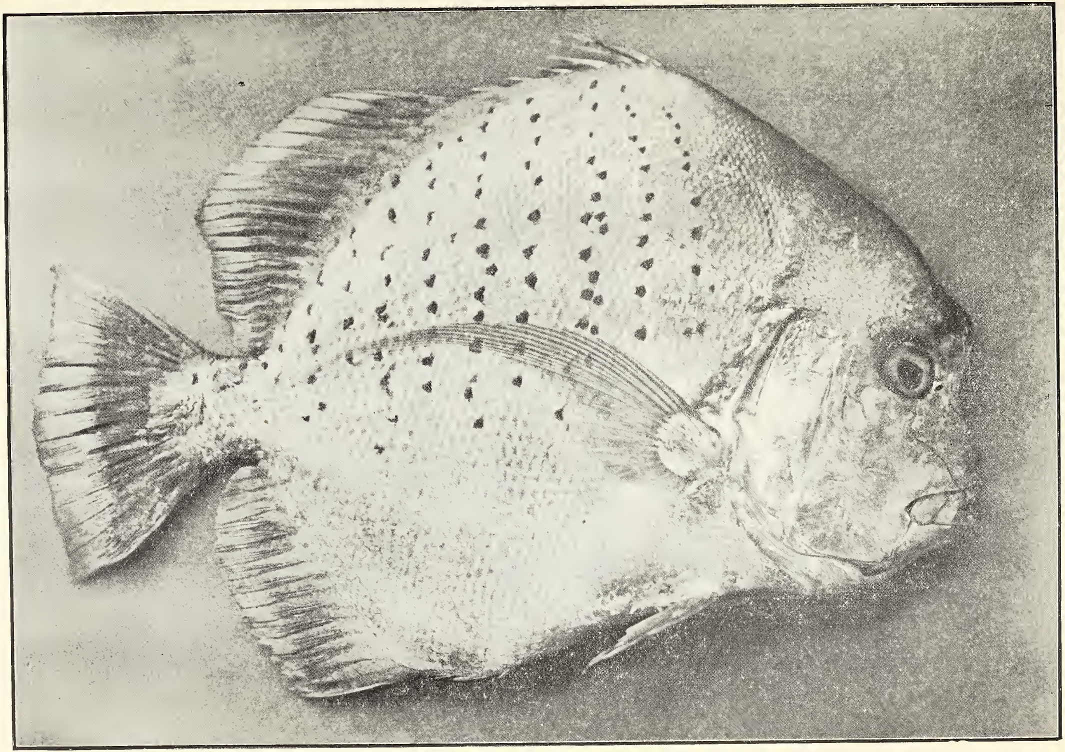
'This fish is known on the Ratnagiri and Canara side as 'Wanwas.' Its scientific name is *Sciænoides brunneus* and, as that name suggests, it has a close relationship to the *Sciænas*, to the same family as which in fact it belongs. It has the appearance of a very slender goal, which fish it also resembles in taste.'

'Our total landings of dori were 4,060 lbs. of which 3,292 lbs were marketed as such (the rest in mixed lots) and fetched altogether Rs. 550. Average price, 2 annas 8 pies per lb. The highest price realized was 3 annas 6·5 pies per lb. in December; the lowest 1 anna 6 pies in February. Day (*Fauna of India. Fishes*, Vol. II, p. 127) says it is common at Bombay in October but from the beginning of September to the middle of December, this fish was almost entirely absent from the trawler catches. Possibly they migrate inshore at this season. They were not found at all off the Sind coast.'

'This species showed more variety in size than most of the sorts taken in the trawl. The longest individual recorded measured 43 inches.

THE 'CHAND'

'The fish known to science as *Drepane punctata* is, from its shape and gleaming silvery colour, very appropriately named *chand*, *chandva* or moon-fish. It is one of the most commonly occurring species in the Bombay neighbourhood and very few catches were made which did not contain *chand* in greater or less numbers. The size of these fish was as a rule very small, from 5 to 8 inches long being the usual range. Small *chand* were frequently not weighed separately but were included in the class called 'small mixed' in both trawler and market records. *Chand* were included in the records of catches from 195 hauls. In 108 of these, they were separately weighed and in 5 cases together with a second species also loosely called 'chand' by the crew but which was as a matter of fact the Karawada (*Ephippus orbis*). The weighings at sea



CHAND (*Drepane punctata*).

(*Reproduced from the Report on the work of the Steam Trawler 'William Carrick'*).

totalled 3,435 lbs. from which (it is estimated) 135 lbs. may be subtracted as representing approximately the weight of the *Ephippus orbis* included, thus leaving 3,300 lbs. as the total weight of the *chand* weighed on the trawler. Out of this total the quantity of large *chand* (i.e., exceeding 12 inches in length) which were caught amounted to only 257 fish, the estimated weight of which would be about 1,200 lbs. The total weight of *chand* as weighed separately when landed for market was 2,594 lbs. out of which 110 lbs. were sold in mixed lots. The 2,484 lbs. of *chand* marketed as such realized a total of Rs. 465, an average of 2 annas 11·2 pies per lb. The highest price realized was 3 annas 5·5 pies per lb. in October; the lowest was 4·8 pies in November.

'A remarkable feature about our catches of *chand* was the absence of fish which might be termed *medium* size. The small rarely exceeded 8″ in length and their individual weight would not as a rule exceed 3 or 4 ounces. Of the large fish, however, the smallest was usually not less than 12 inches long and not less than 3 lbs. in weight. Only 6 medium-sized fish were recorded, their lengths lying between 8 and 11 inches. The largest recorded was a little over 18 inches long. Day says *chand* are 'in most places esteemed as food.' They ought to be esteemed everywhere for the larger ones at least are of excellent edible quality. If properly known, they would, I am convinced, command a good price in Bombay.'

Chand are plentiful in the Bombay market between July and October and the weights vary from 1 to 5 lbs. Retail prices are from 3 to 4 annas per fish.

The above-mentioned ten fish, namely—

Goal or 'Ghol'—*Sciæna* species, probably *Sciæna diacanthus* as it is the large-sized species which is the principal catch.

Pomfret—*Stromateus cinereus* (The Silver Pomfret)
Stromateus niger (The Black Pomfret)

Karel—*Pristipoma maculatum*

Bahmin, *Ravas or Dara*—
Polynemus indicus
Polynemus plebeius (The Indian Salmon)
Polynemus tetradactylus

Wam—*Murænesox telabonoides*
Tambusa—*Lutianus johnii*
Shingala—Family *Siluridæ*, genus *Arius*, species

Dori or Wanwas—*Sciænoides brunneus* (allied to the Goal Fish which it resembles in appearance (though more slender) and in taste)

Chand or Chandva—*Drepane punctata* (The Moon Fish),
and, last of the ten in present-day value but first in quantity and possibly greatest in the potentiality of enhanced value in the future

Wagli (Skates or Rays)

appear to constitute the fish stocks of chief commercial importance available in the vicinity of Bombay for exploitation by trawling or any other bottom-fishing method. There are however other fishes which among the trawler's landings were of relatively minor importance but which require brief notice in order that a proper idea may be presented of the kinds of fish catchable by the trawl in the seas near Bombay.

Mr. Hefford in his report writes :—

'The most important of these is the *Balu* (*Chrysophrys berda*) of which altogether 887 lbs. were marketed and realized Rs. 139, an average price of 2 annas 6 pies per lb. This fish is highly esteemed by all who know its edible qualities. In the Madras Presidency it has received the English name of 'Black-Rock Cod' though its resemblance to the well-known cod of northern seas is difficult to trace. The name 'Black Sea Bream' would better describe its appearance and systematic position in the families of fishes. Our best catch was one of 115 fish weighing altogether 95 lbs. made in 4½ hours in 16 to 19 fathoms, hauling 15 miles W½S from Kundari, on December 17, 1921. The individual sizes usually ranged from 8 to 12 inches (½ lb. to 1½ lbs. weight). Our largest recorded was 14 inches long.'

'There is another fish with the scientific name of *Pagrus spinifer* that figures among our catches which bears a close resemblance to the *Palu* and in fact both belong to the same family (*Sparidæ*). In colouring they are very different, the *Palu* being silvery grey with the edges of the scales outlined in black and a good deal of black about the fins. *Pagrus spinifer* is predominantly pinkish in colouring which renders it very attractive to the eye. As an edible fish it is as excellent as the more sober-coloured Palu. Though quite common off the Sind Coast we found very few of this species in the neighbourhood of Bombay and I have not yet succeeded in finding a Marathi name for it. Our Ratnagiri crew called it *Palu* and then, when its distinction from *Chrysophrys berda* was pointed out, qualified it as *Lal Palu* which, failing an original, might be adopted as its local name. In our trawling record it is termed *Red Palu*. This is the species which, in the *Golden Crown* reports, goes by the name of '*Red Flats*' which was obviously a rough and ready improvisation by the English crew of that trawler. Our European fisherman on the *William Carrick* called it the *Carrick Bream* from the close resemblance that it bears to the British Sea-Bream which belongs to the allied genus *Pagellus*. An English-speaking fisherman of Karachi referred to it as 'Red Snapper' and it is, as a matter of fact, closely related to that important Australian food fish as well as to another Pacific species (*Pagrus major*) which, as the *Red Tai* or *Akadai* figures so largely in the *menus*, the art and the mythology of Japan. *Pagrus spinifer* is a familiar and highly esteemed food fish in Karachi where it is called Dant by the local fisher-people.'

'Our biggest catch of *Red Palu* was one of 625 lbs. numbering approximately 900 fishes of sizes ranging from 6½ to 16 inches. This was from a tow of 5¼ hours' duration made on December 6, 1921, hauling 52 miles south-east from Cape Monze in 17 fathoms depth. This fish was landed for Bombay market on only two occasions. On December 13, 1921, 46 lbs. realized Rs. 9 (average 3 annas

2 pies per lb.). On March 1, 975 lbs. sold for Rs. 50, an average of only 9·8 pies per lb., which low price was doubtless due to the fish being practically unknown in Bombay.

'The *Surmai* or *Seer-fish*,[1] belonging to the genus *Cybium* is fairly well-known and esteemed in the Bombay fish-markets. They do not figure very abundantly in the trawler-catches and those we secured were all of comparatively small size. Our best haul was on February 11, 51 miles south-east from Kundari Island in 14 to 12 fathoms depth when 49 fish having an aggregate weight of 116 lbs. were taken in a 3½ hours' tow. The sizes ranged from 14½ to 26 inches. It will be noted that this haul was made in comparatively shallow water. It is probable that these fish do not habitually swim so near the bottom as to come within the reach of the trawl. Of the five known Indian species, *Cybium lineolatum* and *C. commersonii* appear to be the most commonly occurring in Bombay waters.'

Cybium commersonii to which Mr. Hefford refers is described by Major Lane as an excellent game fish. He calls it the 'Cheetah of the Ocean' and says it preys on mullet, shooting up from below into a school of them and leaping with its prey in its mouth quite 12 feet out of the water.

Common *Surmai* in Bombay to which Mr. Hefford does not refer are *Cybium guttatum* and *C. kuhlii*. *C. guttatum* is abundant in the market from October to January. It is excellent in flavour and salts well and is sold in a dried and salted condition throughout the year. It is the Surmai which is selected for making that much-favoured concoction known as 'Tamarind Fish'. On the Malabar Coast, Seer fish rank 16th as regards quantity and 9th in value. The total catch for 1925–26 was 12,539 maunds valued at Rs. 77,616. The total amount of seer brought to the Madras market in 1922 was 33,004 lbs. valued at Rs. 13,660.

In the Colombo markets, which receive their supplies from all the fishing centres round the coast of Ceylon, the best months for *Cybium* are November, December and January, when the approximate quantities sold daily in 1929 were 3,200, 3,950 and 2,000 lbs. respectively. The species indicated are *C. guttatum* and *S. interruptum*.

Mr. Hefford writes:—

'The 477 lbs. of Surmai sold as such in Bombay market realized an average price of 3 annas 5 pies per lb. The highest was 3 annas 10·5 pies per lb. and the lowest 1 anna 2 pies.

'The Dagola or Dagol, known by the scientific name *Chorinemus*, is another sort of fish with which the fishermen of these coasts are well acquainted, but which came but rarely to our net. Like the Surmai this is a swift-swimming fish and probably moves about in higher levels in the water than are fished by the trawl. About 500 lbs. of Dagola were caught altogether. 406 lbs. marketed in Bombay realized Rs. 67; an average price of 2 annas 7·6 pies per lb.'

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[1] In Karachi, however, the ravas (*Polynemus*) is called Seer.

'*Bhakas* (*Psettodes erumei*).—This fish was called 'Turbot', and sometimes 'halibut' by the Europeans on the '*William Carrick*.' It bears some resemblance to each of these northern species of flat-fish and is the only representative of the great family of *Pleuronectidæ*[1] found in the neighbourhood of Bombay that has any commercial importance or that was commonly taken in the trawl. 551 lbs. is the sum total of our takings of this fish, though it should be noted that there is a liability for the weights of fish taken in small numbers to escape being separately recorded, which depresses the total weight given for the catch of this and other species of minor importance to something below their true amount. Our biggest catches of *Bhakas* were made in voyage xx when one haul produced 55 lbs. in 4½ hours. This was on October 25, 1921 hauling 25 miles N.W.½W. from Kundari Island in 23 to 20 fathoms. On this occasion the larger fish were observed to be sexually ripe and the increased catch was doubtless due to an aggregation for spawning purposes. These mature fish were from 12 to 13 inches in length. The only other species of flat-fish which were of frequent occurrence in our hauls were the fish known to the Ratnagiri fishermen as 'Lep' which belongs to the genus *Pseudorhombus*. These were too small and too few to have any commercial significance. The 'Soles' [2] which are said to be quite common in the shallow inshore waters in the neighbourhood of Karachi were never taken in the trawl except in ones or twos. In the neighbourhood of Bombay very small-sized specimens were occasionally met with.'

The following species of Soles from the Bombay market are in the Society's collection. *Psettodes erumei*, the largest, *Pseudorhombus arsius*, both common and valuable food fishes. Other species include *Solea ovata*, *Synaptura zebra*, *S. orientalis*, *Cynoglossus elongatus* and *sindensis* and *Plagusia bilneata*. On the Malabar coast the Sole fisheries rank 4th in quantity and 7th in value. Total catches from 1925 to 1926 were 104,260 maunds valued at Rs. 1,08,516.

In addition to *P. erumei* in Madras *P. arsius*, *C. lingua*, *Plagusia marmorata*, *S. cornuta*, *S. commersoniana* are noted. *Synaptura* are not esteemed as food. Soles are sold all the year round, but the best months are August and September. In Akyab *C. lingua* is described as common throughout the year in river and sea and esteemed by Europeans. In the muddy water off Akyab the '*Golden Crown*' took *P. erumei* and *C. macrolepidota*, *P. arsius*. The Soles were also obtained off the mouth of the Hugli and further down off the Orissa coast. Trawling over a sandy bottom, the following specimens were obtained:—*Synaptura commersoniana*, *P. bilineata* and *marmorata*.

Sharks and similar fishes.—For the purpose of this review and without going into the question of their precise positions in scientific classification, it will suffice to refer the class of fish which is given in the summary tables of the trawler-catches as 'Sharks, etc.' to the four main kinds contained in it. We do not propose to print the summary tables, but Mr. Hefford's reference is interesting. He writes :—

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[1] This is according to Day's classification. Present-day authorities exclude *Psettodes* from the *Pleuronectidæ*.

[2] *Cynoglossus*, *Plagusia* and *Synaptura*.

'Most numerous were the ordinary forms of sharks known by the vernacular name of *Mushi* which belonged for the most part to the genus *Carcharias* of which there are many species in Indian waters. Some of these attain a very large size but it was remarkable that of all those taken in the '*William Carrick's*' trawl none was ever obtained over five feet in length. The largest recorded individual weight is 65 lbs. (length not recorded). Being relatively unimportant commercially in comparison with other kinds caught in the trawl, the catches of these fishes were not always recorded with complete precision as to quantity. They were sometimes weighed but not counted, sometimes counted but not weighed, and frequently recorded indefinitely as 'a few' or 'several'. And only rarely were they measured. The total of all weighings which were taken amounts to 4,050 lbs. The average weight of all fish weighed and counted is 5·2 lbs.'

'Of Hammer-headed Sharks (*Zygæna*) there are records of 90 individuals caught, of which 55 were weighed. These show an average weight of 9·2 lbs. The heaviest individual weight recorded is 34 lbs. The varnacular name for these fish is *Kanere* (i. e., having big ears). The name is suggested by the projecting flaps on each side of the head which bear the eyes of the fish at their extremities.'

'The remaining shark-like fish which call for notice belong really to the same zoological sub-order as the wagli (rays) viz. the *Batoidei*. These are the *Kandere* or Saw-fishes (*Pristidæ*), characterized by a bayonet-like prolongation of the snout armed on each edge with a series of sharp teeth, and the family known to science as *Rhinobatidæ* which in general shape rather resemble the *Pristidæ* but their pointed snout has no offensive armament. These fishes are named in the local vernacular *Lang* and in Canara are called *Fadka*. Somewhat similar species in England are called Fiddle-fish and in America Guitar-fish.'

'The largest and heaviest individuals of all the fish taken in the trawl were *Kandere* (Saw-fish). These occasionally exceeded 8 feet in total length and were much too big to weigh. There is one record of a saw-fish with a total length of 12½ feet, the tail, fin and breast fins of which alone weighed 46 lbs. Altogether 49 saw-fishes were caught and of those which were weighed, 15 individuals give an average weight of 60 lbs.'

'A total of 49 *lanj* also is recorded. The largest individual record was entered as 'about 100 lbs. weight, probably more'. Twenty-five fish which were weighed show an average weight of 23 lbs.'

'As a rule only the fins of large shark-like fish were kept. The smaller fish were usually regarded as 'stocker bait' for the crew. 894 lbs. landed for market and sold separately, realized Rs. 46 (an average of 9·8 pies per lb.) The highest price realized was 1 anna 9 pies, and the lowest 3 pies per lb. 216 lbs. of shark fins were sold for Rs. 40 an average price of 3 annas per lb. On one occasion 8 annas 7 pies per lb. was realized.'

'Amongst the various fishes described under the term 'small mixed', mention may be made of *Otolithus rubber* a most abundan- species, and of a small-sized species of *Sciæna* at present unidentified, which at times were numerically very abundant. Both sorts are excellent eating when fresh, and there is nothing to be said against them except on the score of size which in our catches rarely exceeded 10 inches (about 4 to 5 fishes to the lb.) The English name 'Whiting' is applied to these fish, as well as to other sciænid fish, in the reports of the Fishery Survey of the Bay of Bengal.'

'Other frequent constituents of the class 'Small Mixed' were *Polynemus sextarius* (a small species of *Ravas* which matures at a length of a few inches and rarely exceeds 8 or 9 inches in length); Saundals (*Lactarius delicatulus*) an excellent fish to eat, but rarely greater than a foot in length; and various species of *Caranx* (Horse Mackerel), which were sometimes fairly abundant. The commonest were Lalbi (*Caranx malabaricus*). Less ahundant were *C. atropus*, *C. rottleri*, *C. kurra* and *C. gallus*. *Scomber microlepidotus*, the true mackerel, occasionally occurred. In the deeper water the very handsome red and yellow *Synagris japonica* and *Synagris bleekeri* were occasionally met with in abundance. Less frequent but by no means uncommon were *Upenoides vittatus* and *Upenoides sulphureus* both very pleasing to the eye and closely related in a zoological sense to the much-esteemed Red Mullet of Southern European seas. The Chorbombil (*Saurida tumbil*) was frequently taken but never in great abundance. Bummaloes, Bombils, or Bombay ducks (*Harpodon nehereus*) were sometimes taken in fair quantities, especially in the shallower water, but these easily damaged fish suffered a good deal of crushing in the trawl and after a trial it was deemed profitless to keep them for market. A good proportion were thrown overboard unweighed. The herring family (*Clupeidæ*) was most abundantly represented by the genus *Pellona*.'

Mr. Hefford's list while it gives some of the principal food fishes of the Bombay markets naturally pays little attention to the species described by him as 'small-mixed'. We have unfortunately no statistics available of the fish supply of the Bombay coastal ports, to give us the quantity and the value of the various species sold. Failing this, it is impossible to arrive at a conclusion as to the species which are really the basis of the local fishing industry or to form an idea of the real economic status of the 10 principal fish obtained by the trawler '*William Carrick*.' Statistics prepared by the Madras Fisheries Department covering the fish supply of the Malabar Coast and South Kanara for the year 1925–26 indicate that the mainstay of the Fishing Industry is the despised cheap fish, classed by Mr. Hefford as 'small-mixed'—Silver-Bellies (*Gerres*, *Equula* and *Gazza*), Anchovies (*Engraulis*), small bony Horse Mackerels (*Caranx*),various species of Sardines (*Clupea*) and Soles and not the highly priced marketable fish such as the *Sciænidæ* (Ghol), Seer (*Cybium*), Cock-up (*Lates*) and Pomfrets. The Director of Fisheries, Madras, in the course of his report says: 'It is a startling, but nevertheless true, statement that the fisherman would hardly be affected and the Fishing Industry in India would suffer scarcely a loss should all the Seer, Pomfret, Whiting and similar highly-priced fish be exterminated, while the loss of any of the smaller bony fish mentioned would inflict irreparable damage to fisheries and fisherman.'

On the Malabar Coast the most important class of fishes from the economic standpoint are Mackerel (Bangras) which are captured in enormous numbers between January and May. They are salted and dried and sold in bundles. After Mackerel comes Oil Sardines (*Clupea longiceps*), Cat fish, Silver-Bellies, Prawns, Sharks, Sole, and Ribbon Fish (*Trichurus*). Seer and *Sciænidæ* (Ghol) take the 9th and 10th place in a list of 42 fishes arranged according to quantity and value.

In the markets of Madras City, prawns and crabs come first in value after which, following in order of importance, are the Horse Mackerels, Silver-Bellies, Ribbon fish, Lactarius, Jew fish (*Sciænidæ*) Anchovies, Sardines, Herrings and Grey Mullet (*Mugil*). In the Colombo markets, which receive supplies from all the coastal ports of Ceylon, the report of the Marine Biologist for the year 1929 indicated the principal species as Horse Mackerel (small), Sardines, Seer, Tuny, Ribbon fish, Queen fish (*Chirocentrus*) and *Aporion pristipoma.*

On the Bombay Coast, Ribbon fish, Silver-Bellies, Anchovies and small bony Horse Mackerel are taken in great quantities. Ribbon fish are sold in enormous number, in a dried condition. They are dried without salt, an important consideration where cheapness is the principal requisite, and, with Bombay Duck form the principal animal food of thousands upon thousands of poor people who cannot afford the luxury of salt fish and as for meat do not taste it twice in a year. In the Bombay markets, Bombils or Bombay Duck are sold between April and October. They are most abundant between June, July and August. They are netted in great quantities at the entrance to the harbour in nets known as *Boshi.* The net resembles a truncated cone and is fixed between two stakes. A small *boshi* with an entrance of 5½ feet is about 20 ft, in length; while a larger one with an opening 33 ft. in diameter may be quite 133 ft. in length. These nets are sunk down the stakes with heavy weights so that the end of the cone lies on the sea bed while the top is as close to the surface of the water as possible. The nets are worked entirely with the tide. They are put down just before flood-tide and are taken up a little before slack water. Bombay Duck, like Ribbon fish, dries easily in the sun without salt. Its relatively enormous jaws armed with numerous teeth can be easily hitched on to those of a brother on the drying line, to the great saving of time and labour when thousands of fish have to be hung.

Both these fish are sold in enormous quantities in temporary and permanent markets all over the Konkan coast where people assemble from far in the interior to barter grain for bundles of dried fish which they carry upon their heads up the foot-paths of the ghats. When fresh, Bombils are sold at Rs. 1-12 to Rs. 3 per 100, dry they cost 8 annas to 10 annas per 100.

(*To be continued.*)

FLOWERLESS PLANTS

BY

MRS. M. ROBINSON, B.A. (T.C.D.), NAT. SCI. TRIP. CAM.

PART V

FERNS AND THEIR ALLIES
(THE PTERIDOPHYTA)

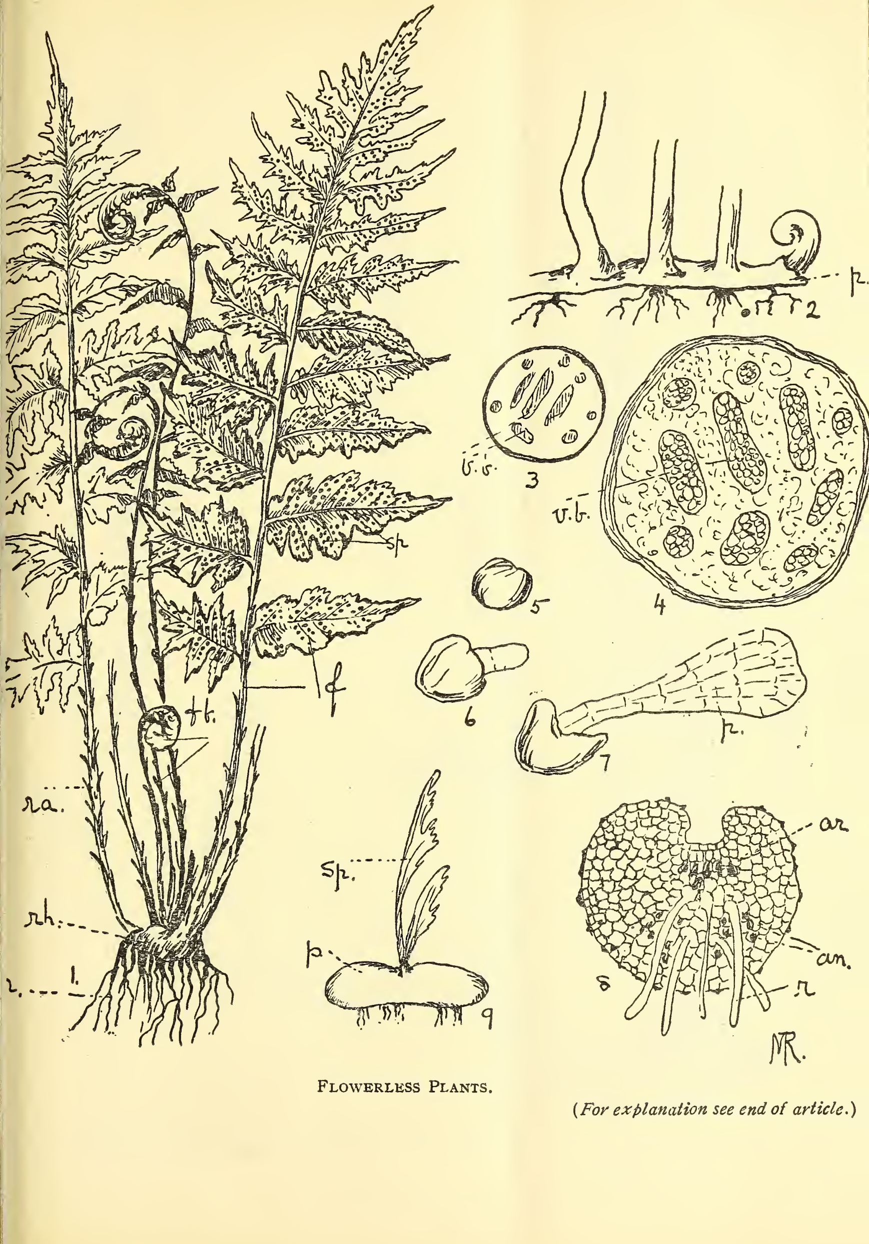
(*Continued from page 430 of this volume*)

(*With 7 plates*)

The last great group of the flowerless plants is perhaps the most interesting of them all. It includes the very large family of the Ferns, the most widely known, and extensively cultivated, of the Cryptogams. Two other small families, one including the *Lycopodiums* and *Selaginellas*, usually known as the Club-Mosses and Stag-horn Mosses, and the other comprising only the *Equisetums* or Horsetails, appear at first sight to differ from the Ferns more than they resemble them, but a closer examination will show that they are nearly related families, having many characteristics in common.

One very interesting thing about these plants is the fact that the group as a whole is of enormous antiquity, and the members of it, that have survived to our own day, are but poor little remnants both in size and in numbers, of their ancestors. In the remote ages of the past, when the geological period known as the Carboniferous age was young, the ancestors of the ferns and the club mosses, and the horsetails, were at the height of their development, and formed the chief vegetation of the world. Flowering plants which now form our primeval forests, and clothe our hillsides with verdure; which provide food for all living animals including man, and paint our country sides and gardens with the glorious colours of their flowers, were then utterly and entirely unknown; they had not come into being. The forests of those days were of gigantic tree ferns, beside which the largest tree ferns of the present day would look small; dense groves of bushy club mosses, eight or nine feet high; and clumps of giant horsetails as large as bamboos, with slender whorled leaves waving in the air, would make a landscape very different from that of to-day. The ground instead of being clothed with the soft springy turf we know, would be carpeted only with mosses and liverworts or trailing *Selaginellas*, or encrusting lichens, but of these no remains have survived, as in the case of the ferns, to tell the full story of the vegetation of the past.

From this ‘ age of Cryptogams ’, as it has been called, many fossil remains of ferns and their allies have survived, and a long series of plants have been found and carefully studied. Many forms are found which no longer exist to-day, showing indeed a gradual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FLOWERLESS PLANTS.

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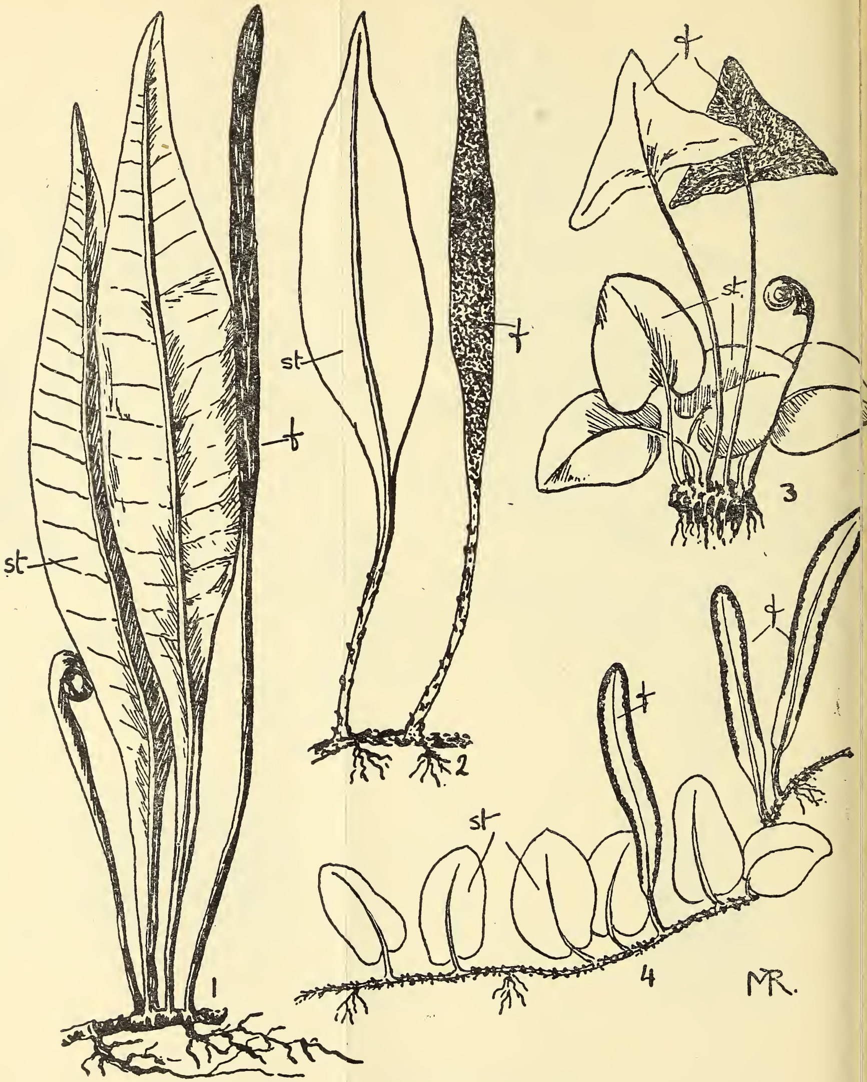
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Flowerless Plants.

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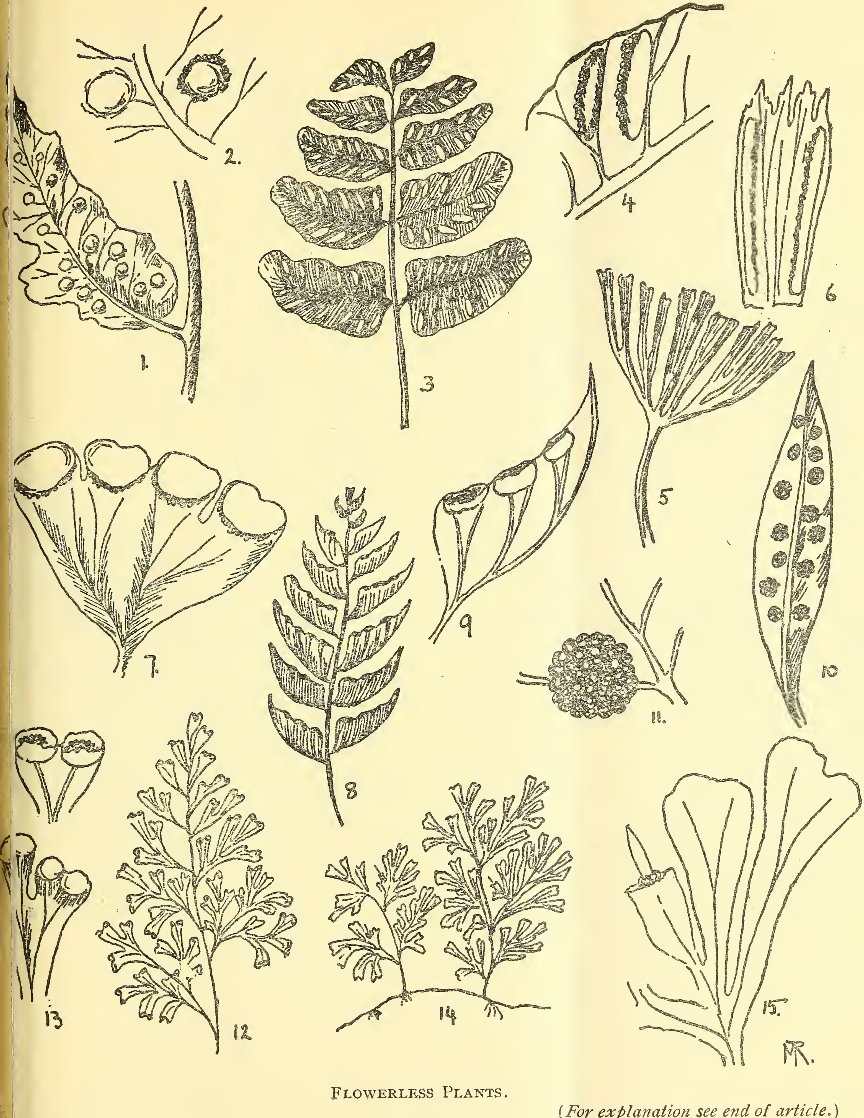
deterioration of the fern group as such; but, on the other hand, seeming to show that the great group of flowering plants have developed from these ferns, through a number of forms showing characters which are intermediate between the two groups. None of these intermediate forms have survived to the present day in living species, but their fossil remains are there even down to the smallest detail for the palæobotanist who can read the 'story of the stones'.

With such a long and distinguished ancestry behind them, it is pleasant to find that though so much reduced in size, the tree fern being now the exception rather than the rule, the number of species of ferns is still very large, and the group still holds its own for beauty and interest in the plant world. Their form is of infinite variety, ranging in size from the tiniest of filmy ferns clinging like moss to the under-sides of the rocks in the beds of streams, to the tall *Alsophila* that lifts its beautiful crown of leaves with its young fronds coiled like great golden brown croziers in the centre, twenty feet or more above the tumbling torrent at its foot. Ferns have always been cultivated and loved for their grace and beauty; there is no form of floral decoration but is enhanced by the presence of the maiden hair fern; and a fernery beneath some large and spreading tree, or on a rockery where few other things will grow, is an abiding joy. In the middle ages before Botany was a science, ferns were regarded as rather mysterious plants, for though the plants came up every year, and increased and multiplied, no flowers and fruits were ever found as in other plants, only some small 'seeds' on the back of the leaves. From these ideas it was but a short step to attribute magic properties to the plant itself, and a legend arose that 'fern seed' which could only be gathered on Midsummer Eve by those initiated into the mysteries, had the property of rendering its possessor invisible. This was disproved by a German botanist, Hieronymus Bock, who published a herbal in 1539, in which a chapter is devoted to a description of how he gathered the seeds of ferns on Midsummer Eve, without any incantations, and in the presence of two other people, and how he found no magic properties in the seeds. Shakespeare would seem to cast doubt on this old superstition, for he makes one of his characters say 'I think you are more beholding to the night, than to fern seed for your walking invisible'!

The 'seeds' referred to are, of course, the spores, which are to be found on the backs of the fronds of most ferns. They are borne in little spore cases or *sporangia*, which are grouped together forming round dots, or streaks, or covering the whole under surface of the frond. The fern plant thus is the *sporophyte*, and when the spores germinate, they give rise to a different generation or *gametophyte*, producing an *alternation of generations*, exactly as we found among mosses and liverworts. The great difference, however, between these two last groups of the Cryptogams, is that in the ferns and their allies the *sporophyte* has become by far the more important of the two generations, whereas in the mosses and liverworts, it is the *gametophyte* which forms the main plant, the *sporophyte* being merely a kind of *capsule* containing spores, attached to it, and having no separate existence from the *gametophyte*. The *gametophyte* of a fern, on the other hand, is much less complex than that of a moss, being in fact merely a flat plate of cells, often heart-shaped, and bearing *antheridia* and *archegonia* from one of which, after fertilization, a *sporophyte* arises. It is known as a *prothallus*, and is very small and inconspicuous, rather resembling a very small and delicate liverwort. Numbers of *prothalli* can often be seen in a fernery, on the surface of the soil, like a thin green film, little *sporophytes* appearing on them very soon. Plate I illustrates a very highly magnified spore, in fig. 5 ; starting to germinate in figs. 6 and 7 ; a fully-grown prothallus magnified about ten times in fig. 8 ; and one bearing a young *sporophyte* magnified about eight times in fig. 9. This *prothallus* very soon dies away, leaving the *sporophyte* to an entirely separate existence, and it soon attains its full development of root, stem and leaves. A typical fern plant, a species of *Aspidium*, is shown in Plate I, fig. 1, where the roots, *r.* spring from the underside of the stem or rhizome, *rh.* which may be short and compact as shown, or may be long and creeping as in *Pteris*, shown in fig. 2. In the tree ferns, the stem continues to grow above ground till it resembles a slender tree trunk, bearing a crown of enormous leaves at its apex. The dead bases of the old leaves remain on the stem giving it a rough and irregular surface. This kind of stem is known as a *caudex*.

The leaves or fronds spring from the upper side of the stem, the younger ones being inside in the compact form, or caudex, and near the growing point of the creeping stem. The young fronds of a fern are always coiled spirally inwards, and this characteristic distinguishes ferns from all other plants, which have their leaves folded and pleated and rolled inwards, but never coiled in the bud. The frond consists of a stem called the *rachis*, and the *blade* or *lamina*. The rachis is often smooth and polished and dark in colour, as in *Adiantum*, the Maidenhair Fern, but is also sometimes covered with chaffy scales or *ramenta*, as in *Aspidium*, seen in Plate I and many other species, or is clothed with hairs of varying kinds. The blade shows great variety both of form and texture. It may be simple and undivided as in the four species shown in Plate II, or it may be cut up into sections or *pinnæ* as in *Asplenium normale*, Plate III, fig. 3, and *Lindsaya cultrata*, in fig. 8. The pinnæ are themselves often divided again and yet again producing a very much cut up leaf such as *Stenoloma*, fig. 12, *Trichomanes* fig. 14 and *Botrychium*, Plate IV, fig. 2. The edge of the leaf may be entire or toothed, or indented in any of the various ways that one finds among the leaves of flowering plants, and the texture may be soft and delicate as in *Adiantum* and the filmy ferns (*Trichomanes*) which can only live in a moisture-laden atmosphere, or may be hard and leathery as in many of the *Polypodiums*, and *Hemionitis* and many others. Every intermediate variety is also found.

A characteristic of the ferns that will at once strike the attention, is that the stems are hard and stiff, and in many instances attain a considerable thickness, as in the caudex of the tree ferns. The leaves have similarly stiff hard stems, and a very definite mid-rib with a system of smaller veins often forming a network over the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FLOWERLESS PLANTS.

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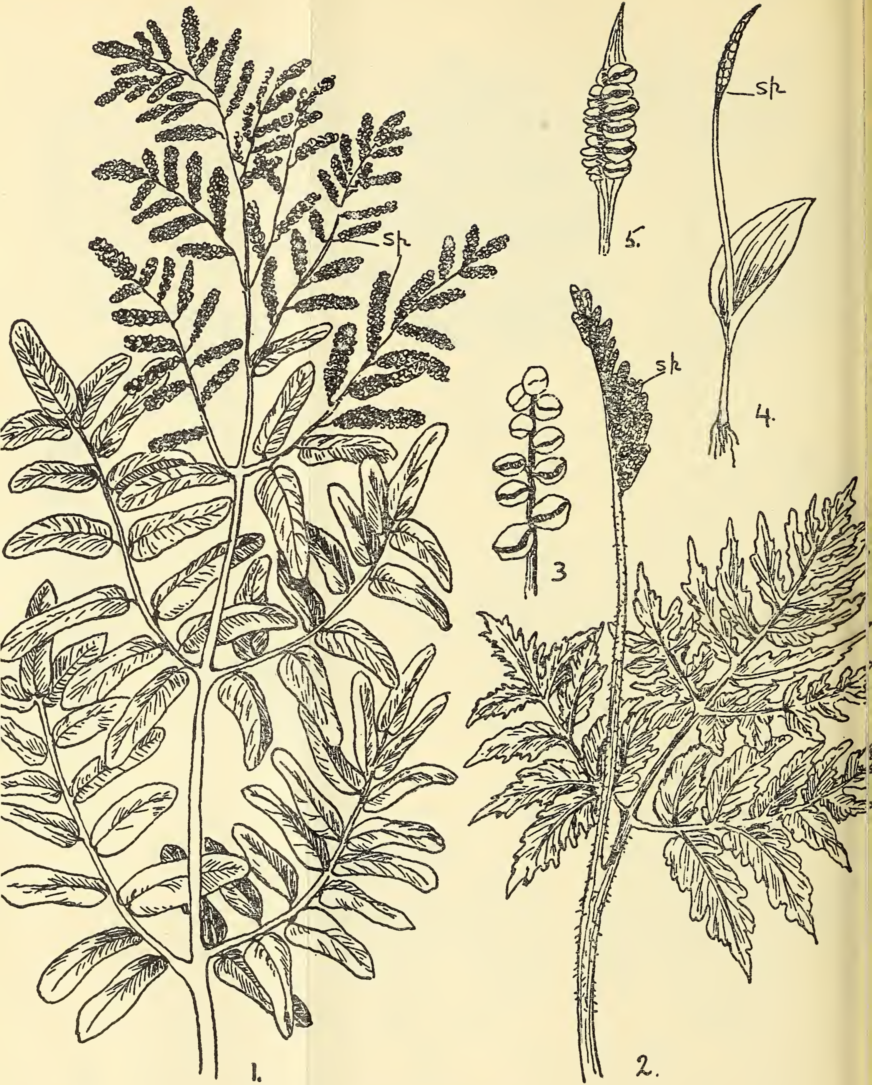
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FLOWERLESS PLANTS.

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whole leaf. The roots too are stiff and wiry, and dark in colour quite unlike the soft colourless rootlets of mosses and liverworts. Evidently here there is a much greater development of cellular tissue, and if a stem is cut across, and the section examined, it will be found to have an appearance something like that illustrated in fig. 3 on Plate I. Little groups of darker tissue are scattered about in the general ground tissue of the stem, and if these are examined with the low power of the microscope, they are seen to be formed of a number of large cells with much thicker walls grouped together inside a layer of dividing cells. The outside of the stem too is surrounded by a layer or two of thicker-walled, harder cells which protect the soft ground tissue. These groups or bundles of special cells run through the entire length of the stem, and continue downwards into the root (where they can be seen by cutting a section in the same way), and also upwards into the leaves, where they form the veins. Their special function is to give strength and rigidity to the plant and to serve as channels through which the water absorbed by the roots passes upward into all parts of the plant. They are known as *vascular bundles*, and as the ferns and their allies are the only group of the cryptogams that have a well-developed vascular system, they are sometimes referred to as the *vascular cryptogams*. The higher plants have a well-developed vascular system, the same in essentials, but differing in many details from that of the ferns. The chief point of difference is that in the higher plants the vascular bundles may increase in size year by year, by the formation of more and more woody cells, until the stem may be entirely of wood as in the case of our forest trees which increase in thickness every year. In the ferns, this increase in the amount of woody tissue never takes place, even in the tree ferns though it has been found in some of the higher fossil types.

When we examine the fronds for the *sporangia*, we find that these may occur in an infinite variety of ways. The back of the frond may show a number of little round dots, regularly arranged along the midribs or near the edges of the leaflets—or there may be a few rather large dots, or they may be kidney-shaped, or oblong, rather broad, or long and thin, and again appear like little cups at the edges of the fronds. Other forms have long, narrow bands running the whole length of the frond, while in some ferns, the whole of the under side is covered thickly with the *sporangia*. Where there are definite little groups of *sporangia* as in the form of dot or oblongs, each group is known as a *sorus*, and the *sorus* is usually covered with a thin skin known as an *indusium*, which protects the *sporangia*. When these are ripe, the *indusium* splits or rolls back allowing the spores to escape from the *sporangia*. In some genera, the *indusium* grows out from the centre of the *sorus* and covers it like a little umbrella, as shown in figs. 1 and 2 on Plate V, which are enlarged drawings of the *sorus* of an *Aspidium*; in other genera, e.g., *Davallia*, *Stenoloma*, *Trichomanes*, it grows from outside the *sorus* which it encloses as in a little cup, and in the big family, *Pterideæ* including *Pteris* and *Adiantum*, both well-known ferns, the *indusium* is formed by the rolled-over edges of the frond. In two or three other families, including the big tribe of the *Polypodiæ*, (Pl. III.

figs. 10 and 11) *Hemionitis*, the Mule fern Plate II, fig. 3, *Drymoglossum* and *Elaphoglossum* all shown on Plate II there is no *indusium* at all, and the *sporangia* can be seen clustered together as in Pl. III, fig. 10, with no covering. Some genera such as *Elaphoglossum* and *Hemionitis* have the *sporangia* spread over the whole surface, and not confined to definite *sori* on the back of the frond. Another variation is found in genera such as the four shown on Pl. II where the *sporangia* are not found on all the fronds, but only on certain fertile ones which differ in shape from the sterile fronds. In *Osmunda*, *Botrychium* and *Ophioglossum* which are all shown on Plate IV, the same frond is divided into two distinct portions—a fertile part which is entirely composed of densely culstered *sporangia*, and a lower sterile portion. This gives a very flower-like appearance to the plant, and *Osmunda* is often spoken of as the flowering fern. All these ferns are found at the higher elevations in India, *Osmunda* and *Ophioglossum* preferring open swamps, while *Botrychium* is found in the sholas.

A *sporangium* is a stalked structure of which the upper, more or less globular head contains the *spores* Plate V, figs. 3–7. In some genera it has a ring of special cells either vertically or horizontally arranged, known as the *annulus* Plate V, figs. 3–7. The contraction of the annulus causes the *sporangium* to open and allows the spores to escape. In some families notably those including *Lygodium* a climbing fern, fig. 5 and *Osmunda*, fig. 7, the annulus is reduced to an apical cap of cells.

There is one large family of ferns including two natural orders, the *Marattiaceæ* and the *Ophioglossaceæ*, which are interesting as having certain characters more in common with the older fossil ferns than have any other of the existing types. The *Marattiaceæ* are all large ferns and include *Marattia*, *Kaulfussia*, and *Angiopteris*, and differ from other ferns in the development of the *sporangia*. Here the *sporangia* arise, not each from a single cell, but from a group of cells, and are fused into a more or less compound structure known as a *synangia*. There is no annulus, and the *synangia* splits open to let the spores escape. A part of a frond of *Angiopteris evecta* is shown on Plate V, fig. 8, with rows of *synangia* at each edge of the pinnæ, at first sight resembling ordinary *sori*. Closer examination with a hand lens, shows each dot to be one *synangium* formed from the fused *sporangia* (fig. 9). In the *Ophioglossaceæ*, the three genera *Ophioglossum*, *Botrychium* and *Helminthostachys* all have the *sporangia* collected on a special spike at the upper part of the frond. The *sporangia* are rather large, and split open into two halves, and there is no annulus. These are shown on Plate IV, figs. 2 to 5.

The ferns of India were collected and studied with great thoroughness by the late Col. R. H. Beddome, F.L.S., a Conservator of Forests, Madras, who published a large work with beautiful illustrations called the 'Ferns of British India.' This, I believe, is now out of print, but a handbook was published in 1892, which is an extremely useful little book for the collector or student. The classification of the ferns given, is very helpful, and more recent work has only introduced a few changes. The following classification of the whole group which has for its Latin name *Pteridophyta* may be helpful :—

THE PTERIDOPHYTA

Filicales ...	... The Ferns
Lycopodiales	... Lycopodiums and Selaginellas
Equisetales ...	... The Horsetails
Sphenophyllales	... Only extinct forms. Fossil remains are found, but none have survived to the present day.

THE FILICALES

The family is divided into two groups, from the nature of the development of the *sporangia*—

A. *The Leptosporangiateæ* where the *sporangium* develops from a single cell of the epidermis and has an annulus. It includes—

I. *Eufilicineæ* the true ferns, divided into the following Natural Orders :—

1. *Hymenophyllaceæ*
2. *Polypodiaceæ*
3. *Cyathaceæ*
4. *Gleicheniaceæ*
5. *Schizeaceæ*
6. *Osmundaceæ*

II. *Hydropterideæ* usually called the water ferns four small and rare genera found in water or swamps. They produce two kinds of spores. *Azolla*, *Marsilia*, *Salvinia*, *Pillularia*, shown on Plate VII, figs. 6, 7 and 8.

Marsilia quadrifolia with its little shamrock-like leaves, and clusters of sporangia near the base of the plant, grows in vast quantities in swampy ground particularly round Cooper's Creek, in the northern part of South Australia. The aboriginal tribes in this district, and probably in others, used to gather the sporangia, and grind them into a kind of flour, which they called ‘ nardoo ’. This they made into cakes, and some writers assert that though nourishing to the aborigines, these cakes are semi-poisonous to whitemen. The members of the famous, but ill-fated exploring expedition of 1860, led by Burke and Wills, were lost in the bush for many months, but were found by aborigines who kept them alive by feeding them on nardoo cakes and on berries. Wills died alone in the bush leaving a last entry in his diary ‘ Starving on nardoo seed is by no means unpleasant, but I should prefer a little fat and sugar mixed with it.’

B. *The Eusporangiateæ*, where the *sporangium* develops from a group of cells, and has no annulus. It includes two Natural Orders already shortly described above.—

1. *Marattiaceæ*, with genera *Marattia*, *Kaulfussia*, *Danaea* *Angiopteris*, *Archangiopteris*, all large ferns.

2. *Ophioglossaceæ* with three genera *Ophioglossum*, *Botrychium*, and *Helminthostachys*. The first two are shown on Plate IV.

THE EUFILICINEÆ

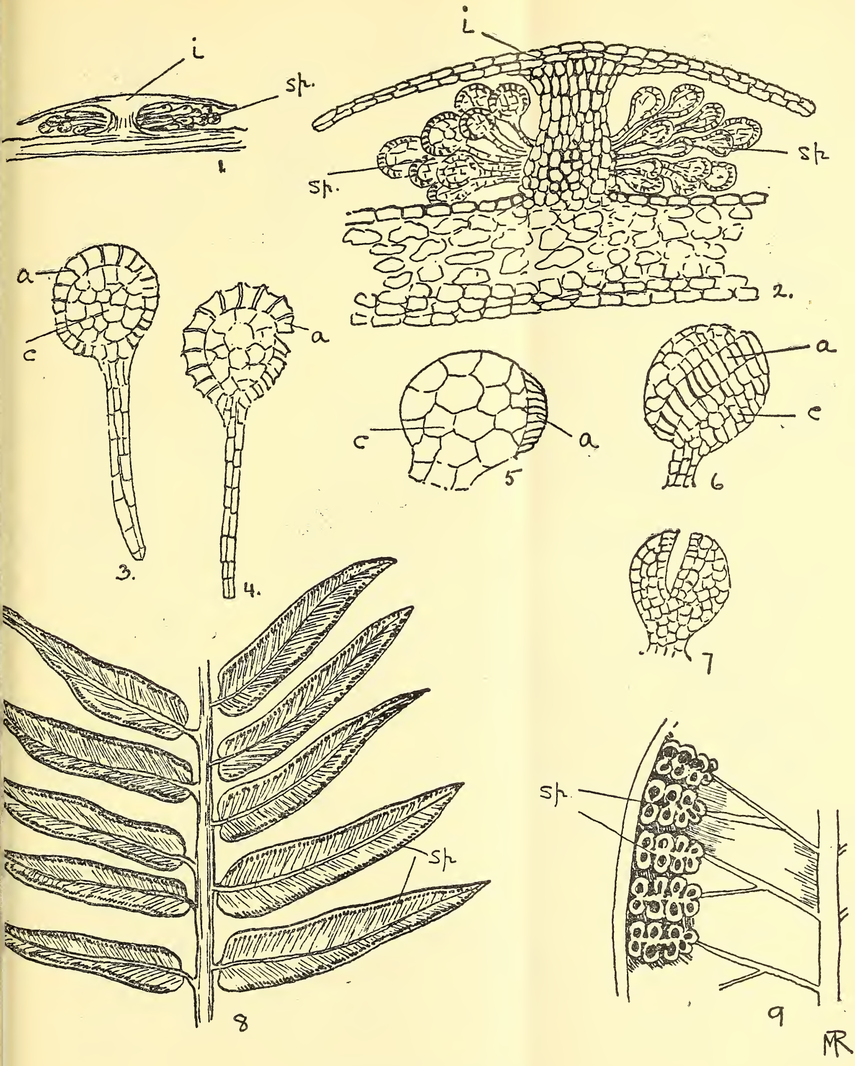
The true ferns form by far the largest class of the *Pteridophyta*, and a few more details of the six natural orders given above, will give a better idea of this great class, but for a complete list and description of the genera, the reader is referred to Beddome's Handbook.

1. *The Hymenophyllaceæ* contains only two genera, *Hymenophyllum* the bristle fern, and *Trichomanes* the filmy fern. Both are found in India and are small, very delicate ferns. The sorus is cup shaped and the centre column bearing the *sporangia* projects beyond the edge of the cup in some of the genera forming the 'bristle' (Plate III, figs. 14 and 15).

2. *The Polypodiaceæ* is by far the largest order of which the distinguishing character is that the annulus is vertical as in Plate V, figs. 3 and 4. It is sub-divided into several large *Tribes* distinguished by the nature of the sori and indusium—

1. *Woodsia*. The indusium is inferior, and splits at the top and turns back in a number of segments.
2. *Aspideæ*. Indusium superior, round or kidney shaped, leaves divided. *Aspidium*, *Nephrodium*, etc., Plate III, fig. 1.
3. *Oleandreæ*. Indusium kidney-shaped, leaves simple, and jointed. *Oleandra*.
4. *Davalliæ*. Sorus terminal, or close to margin which turns back to form indusium. *Davallia*, *Lindsaya*, *Nephrolepis*, *Stenoloma*, etc., Plate III, figs. 8–12.
5. *Aspleniæ*. Sori usually oblong, straight or curved; indusium splitting down side, *Asplenium*, *Scolopendrium* (English Harts-tongue) *Blechnum*, etc., Plate III, fig. 3.
6. *Pterideæ*. Sori terminal, or along the veins, not as a rule true indusium, edge of frond rolls back. It contains the genera *Pteris*, *Adiantum*, *Actinopteris*, *Cheilanthes* (Silver fern) *Gymnogramme* (Gold fern) and many others (Plate III, figs. 5–7).
7. *Vittareæ*, a small tribe of small ferns with usually simple leaves, and marginal sori. The prothallus is more or less filamentous. *Vittaria*, *Monogramme*, *Anthrophyum*, etc.
8. *Polypodiæ*. Another large tribe characterized by having no indusium. Well-known genera are *Polypodium*, *Pleopeltis*, *Drymoglossum* (Plate III, figs. 10 and 11, Plate II, fig. 4).
9. *Acrosticheæ*, a fairly large tribe, where the sori are spread over the whole surface of the fertile fronds, which may differ from the sterile. There is no indusium. *Elaphoglossum*, *Hemionitis*, *Platycerium*. (Plate II, figs. 1–3).

3. *Cyathaceæ*.—The ferns in this Natural Order are all confined to the tropics, and are all large ferns. The indusium is rather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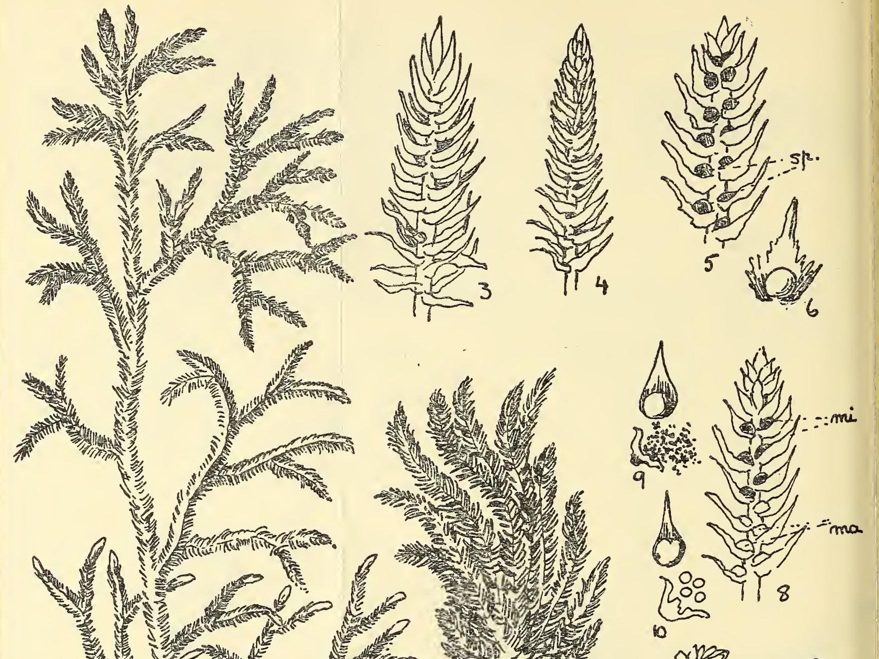
FLOWERLESS PLANTS.

(*For explanation see end of article.*)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FLOWERLESS PLANTS.

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cup-shaped, growing up round the sporangia and opening at the top. The annulus is oblique, resembling that of *Gleichenia* (Plate V, fig. 6). Some genera are *Cyathea*, *Dicksonia*, *Alsophila* (the tree fern).

4. *Gleicheniaceæ.*—This is a small order of three genera *Gleichenia*, *Stromatopteris*, *Platyzoma*, which Beddome places all in one genus *Gleichenia*. They are climbing ferns usually dichotomously branched. The sori are often reduced to only one sporangium, which is rather large and stout and shortly stalked. The annulus is a complete oblique ring (Plate V, fig. 6).

5. *Schizeæ.*—The sori in this order are again reduced to one sporangium which is sessile and has an apical annulus (Plate V, fig. 5). *Lygodium* also a climbing fern has rather large leafy involucres. In *Schizea* and *Anemia*, the two other genera, there is a special fertile segment of the frond, *Anemia* rather resembling *Botrychium*.

6. *Osmundaceæ.*—This order contains two genera *Osmunda*, widely distributed over the globe, and *Todea* which is confined to Australia and New Zealand and parts of South Africa. The sporangia all collected into a fertile spike (Plate IV, figs. 1 and 2) are stout and bulky with a thick stalk, two of them sometimes appearing to coalesce into a single one. There is no real annulus, though a group of slightly thicker-walled cells below the apex are generally referred to as an annulus (Plate V, fig. 7). Several characteristics of the *Osmundaceæ* seem to approach those of the *Eusporangiate* ferns, and it is thought that they may be an intermediate group between them and the *Leptosporangiate* ferns, with which it is classed.

THE LYCOPODIALES

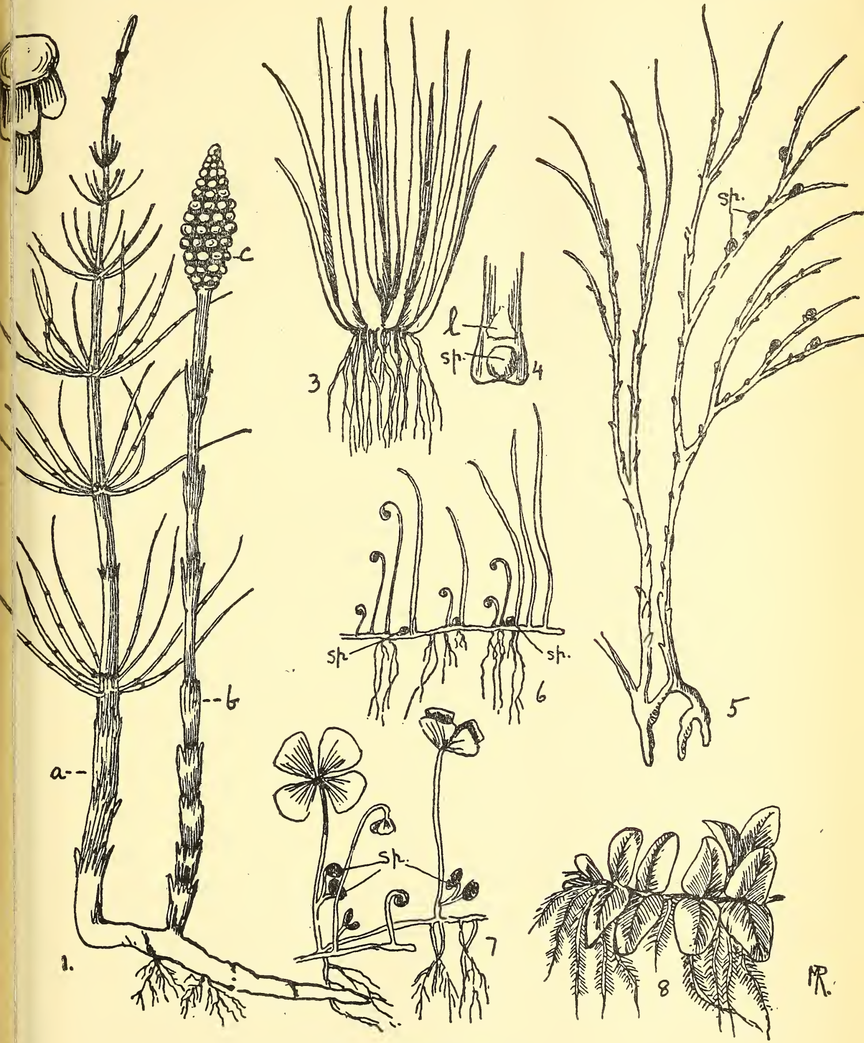
This group of the *Pteridophyta* includes the *Lycopodiums*, *Selaginellas*, and two lesser known plants *Isoetes* and *Psilotum*. Two *Lycopodiums* and a *Selaginella* are illustrated on Plate VI, from which it will be seen that they do not bear much resemblance to the true ferns, being in fact more like large mosses in outward appearance, while their common names of Club-Moss and Stag-horn Moss would seem to indicate that this resemblance is striking. They have nothing in common with the mosses however, as the moss-like plant of *Lycopodium* and *Selaginella* is the *sporophyte*, sporangia being produced in the axils of the leaves. Sometimes special cones of spore-bearing leaves are formed as in fig. 1 Sp. C., in other genera and in *Selaginella*, there is no special cone. In *Lycopodium* the leaves are all of one kind, and the sporangia are all of one kind, as in figs. 5 and 6. In *Selaginella* the stem bears a row of small leaves flat against the upper side of the stem, while larger leaves grow from the lower side, and a very small leaf called a *ligule* is found at the base of each large leaf. In the spore bearing cones, two kinds of sporangia are found. One dark in colour contains numerous very small spores, called *microspores*, the other contains only four large spores, called *macrospores*. The *Lycopodium* spores produce a prothallus much resembling that of a fern, and bearing both antheridia and archegonia. The *macrospores* of *Selaginella* produce a prothallus bearing only *archegonia* or female organs—*microspores* produce a prothallus with only *antheridia.* This production of two prothalli takes place also in the *Hydropterideæ*, the water ferns referred to above as having two kinds of spores.

The two plants illustrated on Plate VII, figs. 3, 4 and 5 are also placed in this order. *Isoetes* shown in fig. 3 is known as *Quillwort*, and in outward appearance bears a strong likeness to several flowering water plants, such as *Lobelia Dortmanni*, and *Litiorella lacustris*, found in the same habitat. The long quill-like leaves however bear sporangia at their bases, *macrosporangia* on the outer, and *microsporangia* on their inner leaves. These develop into prothalli, as do those of their allies the *Selaginellas* and a small *ligule* found just above the sporangium provides another point of similarity with them. *Psilotum* shown in fig. 5 has long slender stems with much reduced scale like leaves, in the axils of which are found the sporangia. It has no roots, growing epiphytically, that is to say it grows upon some other plants, but not drawing nourishment from it, as in the case of a parasite. The root-like bases of the stems absorb moisture from the air and from any mould, etc., that may be lodged on the host, usually a tree. Many ferns are epiphytes.

The Equisetales

This contains only one natural order of one genus *Equisetum*, of which the common British Horsetail—*Equisetum arvense*, which is shown on Plate VII, fig. 1, may serve as example. The sterile shoot bears long, slender, needle-like leaves in whorls, at intervals on the stem. The fertile shoot has reduced leaves, and a cone-like head bearing sporangia arranged regularly round it. Each sporangium has four little sacs of spores, hanging below the rounded head. These split open on the inside towards the stem to liberate the spores.

The discussion of the *Sphenophyllales* is beyond the scope of this paper, as there are no living representatives to be found. The study of these fossil plants is an extremely interesting one, and as already mentioned throws much light on the development of the flowering plants now supreme in the vegetable world, and also on the past history of the flowerless plants, which no longer hold the important place that was theirs in past ages. One group only, the Algæ, has probably held its own in numbers and distribution. Nothing has as yet ousted these lowly plants from the waters of the globe, their natural habitat. No flowering plant has been found in the salt waters of the oceans and seas, where the algæ abound in every variety of form and colour ; every drop of fresh water contains minute species of the algæ, too small to be seen with the naked eye, but often in such numbers as to colour the water with their greenness ; and though many flowering plants are also found growing in fresh water, there will always be found a number of the algæ, the most lowly, but the most persistent of the flowerless plants.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FLOWERLESS PLANTS

(*For explanation see end of article.*)

FLOWERLESS PLANTS

PART V

The Ferns and their allies

Description of the plates

PLATE I

1. A typical fern sporophyte (*Aspidium*) *rh.* short compact stem or rhizome. *f.* frond bearing sporangia on the back. *fb.* coiled young fronds. *ra.* rachis. *r.* roots.
2. Creeping rhizome of *Pteris.*
3. Cross section of rhizome showing vascular bundles v. b. (magnified)
4. The same, highly magnified.

5, 6 & 7. Germination of the spore producing young prothallus p. all highly magnified.

8. Full-grown prothallus ; under side bearing rootlets *r.* antheridia *an.* archegonia *ar.* Mag. 10 times.
9. Prothallus with young sporophyte sp. Mag. 8 times.

PLATE II

FERNS WITH THE FERTILE FRONDS DIFFERING FROM THE STERILE FRONDS.

1. *Gymnopteris variabilis.*
2. *Elaphoglossum conforme* (Stag's tongue).
3. *Hemionitis arifolia* (Mule fern)
4. *Drymoglossum pilosella*, *f.* fertile. *st.* sterile fronds.

PLATE III

DIFFERENT TYPES OF SORI

1. Part of frond of *Aspidium* ; circular sori.
2. Same enlarged *a.* young sorus. *b.* older with sporangia showing at edge of indusium.
3. *Asplenium normale*—oval sori.
4. Same enlarged
5. *Actinopteris dichotoma*—linear sori.
6. Same enlarged.
7. Enlarged leaflet of *Adiantum capillus veneris.*
8. *Lindsaya cultrata.*
9. Same enlarged.
10. *Pleopeltis lanceolata*—one of the *Polypodiæ*—circular sori—no indusium.
11. Same enlarged.
12. *Stenoloma Chinensis* (Lace fern) one of the *Davalliæ.*
13. Same enlarged—*a.* closed sori—*b.* open.
14. *Trichomanes* (Filmy fern).
15. Same enlarged. Cup shaped sorus with prolongation of column in centre on which sporangia are inserted.

PLATE IV

FERNS WHICH HAVE THE UPPER PART OF FROND FORMED ENTIRELY OF THE SPORANGIA

1. *Osmunda regalis* (Royal fern).
2. *Botrychium daucifolium* (Moon wort).
3. Sporangia of same enlarged.
4. *Ophioglossum nudicaule* (Adders tongue).
5. Sporangia of same enlarged.

PLATE V

1. Cross Section of frond of *Aspidium* showing a sorus with sporangia *sp* beneath the indusium *i.*
2. The same highly magnified.
3. Sporangium of *Polipodium*—*c.* capsule on long stalk with annulus *a.*—vertical.

4. Same showing ruptured annulus.
5. Sporangium of *Lygodium*—capsule on very short stalk with annulus *a.*—round the apex.
6. Sporangium of *Gleichenia* with oblique annulus *a.*
7. Sporangium of *Osmunda*—Annulus reduced to slightly thickened cells at apex where capsule splits.
8. Part of frond of *Angiopteris Evecta*—with synangia on under side.
9. Same enlarged 8 times showing synangia.

Plate VI

Some fern allies

1. Part of sporophyte of a common *Lycopodium.*
2. Another species of *Lycopodium.*
3. Enlarged drawing of a vegetative branch.
4. Do. do. fertile branch.
5. Section showing sporangia in the axils of the leaves.
6. One leaf with sporangium.
7. Sporophyte of a common *Selaginella.*
8. Section of fertile branch showing microsporangium *mi.* in upper leaves, macrosporangium *ma.* in lower leaves.
9. Microsporangium with microspores (Enlarged 10 times).
10. Macrosporangium with macrospores (do.)

Plate VII

Some more fern allies

1. Sporophyte of *Equisetum arvense* with (*a*) vegetative and (*b*) fertile branch. (*c*) sporangia clustered round club shaped head.
2. One sporangium containing the spores in the four little pockets below the round top.
3. Plant of *Isoetes* (Quill Wort).
4. Sporangium at base of leaf of same, with small bract or *ligule* just above.
5. Sporophyte of *Psilotum.*
6. Sporophyte of *Pillularia sp.* sporangia.
7. Sporophyte of *Marsilia sp.* sporangia.
8. Sporophyte of *Salvinia.*

Nos. 6, 7 & 8 all reduced, and after Strasburger.

THE BUTTERFLIES OF COORG

BY

J. A. Yates.

Part I

In March 1927 I suggested to Col. H. C. Winckworth, whom I knew as an enthusiast, that I might try to collect a few butterflies on his behalf in Coorg. I had travelled and inspected all over the province almost every year for eleven years, and had observed that butterflies were abundant, more especially at certain seasons, as immediately after the monsoon ; but doubtless my observation was attracted chiefly to the larger and brighter species, and was lacking in intelligent detail. I had in that March only three days at my disposal to observe and collect. Col. Winckworth lent me the necessary apparatus and gave me suitable instructions. I came back with 70 odd species, and was encouraged by this, as I thought, considerable success to continue. Col. Winckworth and I spent Easter on the ghats, and in May I was back again on duty. My work frequently took me across country and through the forests and woodlands : whereas before, on these expeditions, I had no special interest as I went along, I had now something definite to observe. I made it a habit to spend Sundays and holidays at likely spots. On two occasions I took ten days' casual leave in pursuit of my hobby. And at the end of my time I had, preparatory to retirement, a little over two months' leave in India, which I spent very agreeably for the most part on the ghats on the hunt for fresh rarities.

Rather too late it struck me that I might bring Mr. F. Hannyngton's list (*Journal of B. N. H. S.*, vol. xxiv, No. 3, p 578) up to date. I say too late, for if I had thought of this revised list earlier, I might have found in Coorg certain common species that I had obtained in the dry jungles round Bangalore.

Unfortunately Hannyngton gave only partial details for all groups except *Hesperidæ*. Thus he gives the total of *Papilionidæ* as 18 : it would be valuable to know if he took *Pathysa nomius nomius* in Coorg ; if he did, the total would be raised to 19. *Pathysa nomius* is not a rare insect in certain jungles round Bangalore ; I cannot help thinking that it should be found in the eastern dry forests of Coorg. Unfortunately my work did not permit me to get to the Eastern forests between June and September ; and in April and May I could only pay a casual visit to them. Round Bangalore *P. nomius* flies from April to August, so far as I have observed. Does it fly at the same time in the eastern areas of Coorg ? I have not seen it in the evergreen area, where *Pathysa antiphates naira* is prevalent.

Again a complete list of Hannyngton's *Lycænidæ* would have been most helpful to me ; did he take *Azanus uranus*, *Azanus jesous*, *Pratapa deva* and *Iraota timoleon*, the first two and the last of which I took near Bangalore, but did not take in Coorg, probably because I did not seriously look for them at a time when I had not this list in view. In his totals he gives *Morphinæ* 2 : *Discophora lepida*, I take it, must be one : what is the other ? Is it *Amathusia phidippus frederici* ; which Brigadier Evans gives as South Indian species ? If so, another would have to be added to the total.

I have included in my list *Euthalia telchinia*, which a schoolboy collecting for his school brought back from the Sampje ghat to Bangalore : it is in the museum of Bishop Cotton Boys' School. I have no more reason to doubt its existence in Coorg than to doubt that I obtained the following at the spot where *Euthalia telchinia* was obtained : *Gerydus biggsii*, *Nacaduba pactolus continentalis*, *Amblypodia abseus indicus*, Riley and *Itys miscrostictum.* The first and third of these are represented in my collection by single specimens. Since they were found in a new region, I have deposited them in the Natural History Musieum, South Kensington.

Since Hannyngton's list was published Brigader Evans' indispensable 'Identification of Indian Butterflies' has appeared in book form. Without it, I should have frequently been at sea. I must also acknowledge with gratitude Brigadier Evans' frequent kindness in identifying species for me. With his book and his help I have been able to piece together this incomplete record, which includes all the species mentioned by Hannyngton and all the species that Col. Winckworth and myself obtained.

It is my opinion that there are quite possibly more species to be discovered in Coorg, and particularly in the dense evergreen forests on the Western slopes of the Ghat. There are quite remarkably many species that are common to the North East of India, Burma and to the South West forests ; similar conditions account for their appearance in areas so far apart, I suppose : and it is perhaps not more difficult to account for the separation of these tropical butterflies from the rest of their race or from their close relations in N. E. India, than it is to account for the isolation of palæarctic species on the Nilgiri and Palni hill-tops. One would have thought that the races of S. W. Indian forests would have approached, if not been identical, with the special Ceylon races ; apparently this is not the case. To take two cases :- '*Nacaduba pactolus continentalis*, Fruh. Sikkim-Burma' (Evans), and '*Amblypodia abseus indicus*, Riley. Sikkim-Tavoy' (Evans) are, it would seem, the Coorg races, and not the nearer *Nacaduba pactolus ceylonicus* and *Amblypodia abseus mackwoodi*, Riley respectively from Ceylon. May there not be more species discoverable in Coorg ? I do not expect them to be common or easy to get, but I feel that the Coorg forests have not been combed out. Neither Hannyngton nor Col. Winckworth nor myself were able to search all or anything like all the likely spots in this—entomologically speaking—rich little provinces. The forests on the western slopes are so dense, that there are many places that only a full-time collector could reach. All the ghats, not merely the two principal ghats, to the West Coast might well be hunted, *e.g.* the Shiradi ghat the Bisili ghat, the track from Bhagamandala to S. Kanara, the old ghat road *via* Heggala to Tellicherry, up which Abercrombie climbed to reach Seringapatam, and various other paths, used only by woodlanders, down to the plains. The streams and openings along these tracks should afford rich opportunities for collection and might well produce further species hitherto unrecorded from S. India.

I should like to put on record the great help I received from Mr. P. C. Uttaya, who was my assistant in work, who accompanied me on most of my treks across country who frequently gave up his holidays to join me in mine on butterfly hunts.

The following are my totals—

Papilionidæ	...	... 18
Pieridæ	...	... 31
Danaidæ	...	... 10
Satyridæ	...	... 22
Amathusiidæ	...	... 1
Nymphalidæ	...	... 50
Lycænidæ	...	... 80
Hesperiidæ	...	... 66
	Total	... 278

If *Curetis thetis* and *Curetis æsopus* and if *Neptis nandina hamposni* and *Neptis soma kallura* are to be treated as four separate species instead of two, the total is 280. If other gaps in my information could be filled, I am sure the total would be over 280.

[Note :—I have treated *Catopsilia crocale* and *Catopsilia pomona* as separate species. I very much doubt however if they are strictly separate, since they merge so frequently one into the other. Is there any obvious difference between them in their larval stage ? So far as I can discover, there is none.]

[References to Evans' *Identification of Indian Butterflies*.]

I.—Family. PAPILIONIDÆ

A 1. **Troides minos**, Cr. Found in the evergreen area both above and below the ghats. Mostly flies or floats high among the tree-tops, but comes down to feed on lantana and other flowers, in the morning till about 10 a.m., and again in the afternoon from about 4 p.m. Does not seem to descend to drink at wet patches. I have however caught ♂ and ♀ mating on the ground.

A 2. 8β **Byasa jophon pandiyana,** M. Taken mostly on the slopes of the Western Ghats and at the foot of the ghats, where it is not uncommon. Except at feeding time, i.e., until about 10 a.m. and from 4 p.m., it does not seem to fly much in the open, but can be caught inside the forest flying low. I have watched it float leisurely from the forest up deep gullies to the open road. It is most common in April-May and September–October, but can be caught occasionally in other months. Not taken at water on the ground.

A 2. 9. **Byasa hector,** L. As elsewhere, flies in Coorg at all times. Not at water.

A 2. 10β. **Byasa aristolochiæ aristolochiæ,** F. Universal, not taken at water.

A 3. 5β. **Chilasa clytia clytia,** L. More usual in the evergreen parts of the country. Taken on flowers, and at water in the hot part of the day.

Var. dissimilis, L. Similar in distribution and habits to the typical form.

A 4. 1β. **Papilio polymnestor polymnestor,** Cr. Throughout the country, but more frequent in the evergreen area and in the months March-May and September-October, comes freely to water. I have a specimen [♀] with the 'red basal markings' as clear above as below the forewing.

A 4. 10α **Papilio paris tamilana,** M. Well distributed but more frequent in the evergreen areas. Feeds throughout the day on flowers and comes down to water but not so freely as *polymnestor* and *daksha.*

A 4. 13. **Papilio crino,** F. Though common enough in the Nilgiris, this butterfly is, in my experience, rare in Coorg. I have not seen it on the ghats, but have taken it or seen it only above the ghats, at Kolakeri near Napoklu in evergreen country, and near Ponnampet where the forest is of the intermediate or mixed type.

A 4. 14. **Papilio buddha,** Wd. Not uncommon in the evergreen country both above and below and on the ghats : far commoner in Coorg than *P. crino.* It is more frequent in the months *April-May* and *September-October,* but is occasionally seen in other months. I have never seen it at water.

A 4. 16. **Papilio dravidarum,** W.M. This is distinctly a butterfly of the evergreen country. I have taken it above, below and on the ghats. At certain seasons it is fairly common, e.g. March to May and September-October. It was common, for instance, in May at the crossing of the Kakkotpole River into Marinad (3,000 feet) and in March on the Paiyaswani R. [Sampaje ghat]. At both places it came freely to water about 11 a.m. I have taken it at Watecolli at 2,000 feet, Appugala (five miles from Mercara). Parane, Kolakeri (near Napoklu), Ajjemada Stream (Brahmagiri in the S. East of Coorg) and elsewhere. It is commoner than *P.s clytia* in Coorg.

A 4. 19 β. **Papilio helenus daksha,** M. Well distributed, but commoner, and at times almost abundant in the evergreen forest on the western slopes. Taken both on flowers and at water, to which it comes freely. Most abundant March-May and September-October.

A 4. 25α **Papilio polytes romulus,** Cr. All three forms of ♀ taken. Universal and very common, but ♀ *var. cyrus* rare. Comes to water, but not so freely as the last.

A 4. 26α. **Papilio demolion liomedon,** M. In my experience in Coorg more frequent than *P. crino,* but rarer than all the other Papilionidæ found. I have taken it above the ghats, on the slopes and at the foot of the ghats, always in evergreen forest. I took several at Sullia in S. Kanara. It affects *Mussaenda frondosa,* lantana, clerodendron and other flowers. In the middle of the day it seems to retreat into the shade and haunts the sides of dark streams, resting either on bushes or stones away from the sun. Occasionally comes to water. I have taken it in September-October, November, December and again in April and May.

A 4. 27α **Papilio demoleus demoleus,** L. Universal ; a sun-lover ; taken on plants and at water.

A 5. 6β **Pathysa antiphates naira,** M. In my records appears in December and continues till May. According to Hannyngton the race is identical with the Travancore form figured by Bingham as typical' ; '*uph* gray tornal area extending as a broad band to the costa' (Evans). But it first appears in a D.F.S. without a grey tornal area or band : it approaches the typical form, which from my observation appears in March, through intermediate stages of grey area extending from the tornus. D.S.F. characteristics are seen also in the limitations of the black bands *fw*. The butterfly is widely distributed in the evergreen area, above and on and below the ghats. [I have taken or seen it in the following localities : Kolakeri and Panur near Napoklu ; Appugala, between Mercara and Napoklu ; Bekkusodlur near Ponnampet ; Kakkotpole River, crossing to Marinad ; Periambadi and Sampaje ghats.] It flies rather high early and in the afternoon ; as soon as it becomes hot it descends and goes up and down streams or roads in search of water, for it is a very thirsty creature. Once it has settled it does not so easily take alarm as do the Pierids ; the latter often try to chase it away, but it is presistent and once settled will remain, when Pierids in seeming hundreds will rise scared by a net. In March and April 1929 it was almost abundant on the Sampaje ghat road, 13½ miles from Mercara, and at the Paiyaswani River below.

A 6. 2*a*. **Zetides sarpedon teredon**, Fd. Perhaps the commonest ***Papilio*** in Coorg. Present in all areas ; abundant in the evergreen country : on flowers, and on damp ground, where dozens may often be seen in seried rows.

A 6. 3β. **Zetides doson elaeius**, Fr. Not so abundant in Coorg as the last, but still very common ; general throughout. Habits similar to those of ***teredon***, often settles on mud among *teredon*, also in serried rows separately.

A 6. 8*a*. **Zetides agamemnon menides**, Fruh. Much less common in Coorg than the last two. But whereas they are not apparently found in the drier areas of the Mysore plateau, *agamemnon* is generally distributed. It does not favour muddy patches, as *teredon* and *doson* do : generally caught on flowers.

II.—Family PIERIDÆ

B 1. *a*. **Leptosia nina nina**, F. Common everywhere. A feeble flier : moves in and out of bushes or undergrowth, keeping low.

B 6. 2. **Delias eucharis**, Drury. Common on Coorg as elsewhere, but not so common as *Prioneris sita*, Fd. Comes down to water.

B 7. 2. **Prioneris sita**, Fd. Common throughout S. Coorg, i. e., the evergreen and in certain places on the ghats almost abundant. Taken commonly at the foot of the ghats. Best seasons, September—October, and March to May, but fairly plentiful in December-January. A stronger flier than the last ; comes freely to water.

B 8. β. **Belenois mesentina mesentina**, Cr. This is not a common butterfly of the evergreen forest. It is common in the drier country, e.g., the Mysore plateau.

B 9. ·2 *a* . **Huphina nerissa evagete**, Cr. Common in Coorg and generally distributed, both W. S. F. and D. S. F., but not so abundant as the next in the evergreen area. Comes down to water.

B 9. 3 β. **Huphina nadina remba**, M. ♂ ♂ are very common throughout the evergreen and intermediate areas, especially the former. ♀ ♀ shy and scarce ; they seem to prefer the protection of the jungle. Comes to water freely. D. S. F. appears about November and continues till February. There are intermediate stages between D. S. F. and W. S. F.

B 10. 3 *a*. **Appias indra shiva**, Swin. [' Most likely to be found along the foot of the ghats ' (Hannyngton)]. ♂ ♂ abundant December to February on the eastern side of the high hills crowning the ghats (Swamimale, Tandiendamolu and Brahmagiri) and on the ghats (e.g. at Watecolli on the Periambadi ghat, and at Jodpalar and other spots on the Sampaje ghat); less abundant at the foot of the ghats (e.g. Urti). W. S. F. appears in March and again in September. ♀ ♀ by comparison very rare : in my experience haunts clearings, glades and streams inside the forest, where they are more protected. ♂♂ come freely to water.

B 10. 4 *a*. **Appias libythea libythea**, F. Hannyngton gives it as in Coorg. All my specimens were taken in the dry jungles round Bangalore. I failed to take it in Coorg.

B 10. 5 β. **Appias lyncida latifasciata,** M. Fairly well distributed, but not common. Always found in the neighbourhood of rivers and streams. ♀♀ relatively rare. Caught chiefly on flowers e. g., Ramtulasi, (a verbena), wild gingelly, a wild jasmine. Also at water. Flies up and down and across streams. D. S. F. November to February or March.

B. 10. 6 β. **Appias albina darada,** Fd. It is much the commonest *Appias*. Its number is legion in Coorg on the ghats. [Fairly common also in the dry jungles round Bangalore.] ♀♀, *var. semiflava*, were almost abundantDecember (1928) to March 1929. I took one specimen of *var. flava*, apparently identical with the Ceylon species, in January 1929. Comes to water in hundreds at times of abundance. I think R. (rare) in Evans' list must be a misprint.

B 10. 7 β. **Appias paulina wardii,** M. ['Most likely to be found along the foot of the ghats' (Hannyngton)]. Most common on the ghats, but to be found fairly frequently above the ghats in the intermediate country. ♂♂ at times abundant, especially at water among **A. albina** and **A. indra shiva.** ♀♀ rare or at least shy ; seem to seek the protection of jungle. D. S. F., appearing in October, is replaced by W. S. F. early in February.

B 11. 1
B 11. 2 } **Catopsilia crocale** Cr. **and Catopsilia pomona,** F.

B 11. 4. **Catopsilia pyranthe minna,** Herbst.

B. 11. 5. **Catopsilia florella gnoma,** F.

All common, but not so abundant in Coorg as *A. albina darada*. Not gregarious, however, as *A. albina*. All come to water.

B 15. 1. **Terias libythea,** F.

B 15. 2 α. **Terias venata venata,** M.

B 15. 3. **Terias laeta,** Bov.

B 15. 4 α. **Terias blanda silhetana,** Wall.

B 15. 5 α. **Terias hecabe simulata,** M.

B 15, 7 α. **Terias sari ormistoni,** Watkins.

(1) **Terias blanda silhetana** appears to be commoner than *T. hecabe*. At Urti I took a curious dirty white freak, a case of albinism, I suppose. I saw another at the same spot.

(2) **Terias sari.** I have obtained only in the evergreen forest of the ghats, generally rather low down. It is rather a feeble flier and prefers the shade to the open sunlight. Caught near small streams and springs by the roadside (Urti, lower part of Periambadi ghat and lower part of Sampaje ghat).

B 17. 1. **Ixias marianne,** Cr. More in the eastern dry forest area.

B 17. 2 B. **Ixias pyrene frequens,** But. Everywhere from dry to evergreen country.

B 18. 1 α. **Colotis amata modesta,** But.

B 18. 4 α, **Colotis fausta fulvia,** Wall.

B 18. 5β. **Colotis etrida etrida,** Bov.

B 18. 6. **Colotis eucharis,** F.

B 18. 7 α **Colotis danae danae,** F.

Seldom in the evergreen country. I have not taken *Colotis fausta* myself in Coorg. Hannyngton records it from the eastern border.

B 19β. **Hebomoia glaucippe australis,** But. Common throughout the country and especially in the evergreen area. Flies higher than other *Pieridæ*, round the tops of flowering trees, but comes down to flowering bushes (lantana, etc.), and frequent at water with *Papilio* and *Appias*.

B 20. 2 α. **Pareronia ceylanica ceylanica,** Fd. A butterfly of the evergreen forests. I have only seen and taken it, resting momentarily and feeding on flowers, on the Periambadi ghat. It is certainly not common in Coorg.

B 20. 3. **Pareronia valeria hippia**, F. Haunts the dry areas on the eastern borders of Coorg, to which it spreads from the Mysore country, e.g., Hebbale, Alur forest, Fraserpet. Flies in the neighbourhood of streams and tanks; settles on bushes: not seen at water.

III.—Family DANAIDÆ

C 1. 1β. **Hestia lynceus malabarica**, M. Common on the Western Ghats and in other evergreen localities above the ghats. Not observed at water. Floats lazily about trees and bushes.

C 2. 1α. **Danais aglea aglea**, Cr.

C 2. 7. **Danais nilgiriensis**, M.

C 2. 9. **Danais limniace mutina**, Fruh.

C 2. 10β. **Danais melissa dravidarum**, Fruh.

C 2. 12. **Danais plexippus**, L.

C 2. 14. **Danais chrysippus**, L.

With the exception of *D. nilgiriensis*, all common throughout Coorg. *D. aglea*, *limniace* and *melissa dravidarum* frequent in crowds *Crotolaria* plants. *D. nilgiriensis* I have only seen at Irpu under the Brahmagiri Range on the border of the Wynaad, and at Mercara high up, near the Chief Commissioner's Bungalow and the hills behind. At Mercara *Vanessa indica-pholæ*; another Nilgiri insect, rare elsewhere in Coorg, is not uncommon from November to about January.

C 3. 6β. **Euploea klugii kollari**, Fd.

C 3. 15β. **Euploea core core**, Cr.

C 3. 18β. **Euploea coreta coreta**, God.

All the *Euploeas* frequent plants of the *Crotolaria* family. *E. klugii kollari* is by no means common. Both *E. core and E. coreta* are abundant. *Euploea*, unlike *Danais*, particularly affects wet roads and mud patches.

IV.—Family SATYRIDÆ

D 2. 3α. **Mycalesis anaxias anaxias**, Hew. Well distributed throughout the evergreen area, but not abundant. It seems to prefer rather deep shade, and is less inclined to stray into the open than most other *Mycalesis* in Coorg. I have frequently taken it flying in wate with *Zipœtis saitis*.

D 2. 9α. **Mycalesis perseus typheus**, Fruh.

D 2. 10α. **Mycalesis mineus polydecta**, Cr.

D 2. 11. **Mycalesis igilia**, Fruh.

D 2. 14. **Mycalesis subdita**, M.

D 2. 16β. **Mycalesis khasia orcha**, Evans.

Of these five species. *M. subdita*, which is the usual *Mycalesis* in the drier country round Bangalore, seemed to me to be the least common in Coorg.

D 2. 20. **Mycalesis adolphei**, Guer. As observed by Hannyngton, obtainable only on the high hills of the Western Ghats. It is however obtainable for a considerable distance both on Swamibetta and Tadiendamolu. On the latter it is to be had within ½ mile of Nalknad palace, at about 4,000 feet: and at much the same altitude on Swamibetta.

D 2. 32β. **Mycalesis patnia junonia**, But. Throughout the province in woodland; common.

D 3. 23α. **Lethe europa ragalva**, Fruh. The least common of the three *Lethes* in Coorg; in fact rather rare.

D. 3. 24α. **Lethe rohria nilgiriensis**, Guer. Not uncommon and well distributed both in the deciduous and the evergreen area.

D. 3. 25β. **Lethe drypetis todara**, M. Very common, especially in the intermediate and evergreen areas.

D 14. 8. **Yphthima chenui**, Guer. Rare. I have taken it at 4,000 feet on Swamibetta. Hannyngton reports it as only near the summit of the same mountain.

D 14. 9. **Yphthima ceylonica**, Hew. Not common in Coorg, so far as my experience goes.

D 14. 10β. **Yphthima hubneri hubneri**, Kirby. Very common everywhere in woods.

D 14. 14α. **Yphthima baldus madrasa**, Evans. Very common.

D 15 1. **Zipœtis saitis**, Hew. Quite common before and after the monsoons, i.e., March (last half) to May, and September to November. Also ' during the monsoon ' (Hannyngton). Occasionally to be had in other months, e.g., December and January; but it is rare in the dry months. Haunts the evergreen forest of the western slopes, and particularly favours *wate* and damp jungle by streams and rivers. Occurs also above the ghats on the eastern slopes of the hills, as at Kakkotpole River (Marinad). Floats at 4 to 7 feet above the ground through the *wate* clumps. [*wate* = *Ochlandra rheedii*].

D 16α. **Orsotriæna medus mandata**, M. Common, at least in the intermediate and evergreen areas.

D 22. 1. **Melanitis leda ismene**, Cr. Abundant everywhere in woods.

D 22. 2β. **Melanitis phedima varaha**, M. Fairly common in the intermediate and evergreen areas. I have no record of it from the dry forest.

D 22. 3α. **Melanitis zitenius gokala**, M. 'Is decidedly rare in Coorg' (Hannyngton). My captures of it were all in the evergreen and intermediate areas, by the side of afforested streams.

D 24. **Parantirrhœa marshalli**, WM. First recorded from Coorg by Col. H. C. Winckworth R.A. M.C. I have taken it, both ♂♂ and ♀♀, at various places on the Periambadi ghat, where *wate* (*Ochlandra rheedii*) is abundant, from Urti at the bottom to a spot above Watecoli. It occurs to my certain knowledge for ten months of the year—September to June. I have also seen it on the old disused ghat road at Heggala. It is, I think, not uncommon in its special haunts, though never easy to get. It seems to have two main flushes in the year—April-May and September-October.

D 25. 1α. **Elymnias hypermnestra caudata**, But. Well distributed through the intermediate and evergreen areas. I have not seen it in the deciduous forest. It is at times, e.g., April and October, almost common on the ghats. It flies higher, settling on trees and tall bushes, than most other Satyrids; also comes more into the sunlight.

V.—Family AMATHUSIIDÆ

E 10. 3β. **Discophora lepida lepida**, M. Not uncommon on the ghats, but hard to get because of its habits. The ♂♂ normally do not come into the open by day; especially do they avoid the sun. Early on damp misty mornings, e.g., in October after rain, they may be occasionally caught sitting on a leaf, with folded wings, on the edge of the jungle. They may be disturbed during the day in dark deep jungle. They do not fly far then, but dash from cover to cover. In the evening just before dark, at about the same time as *Parantirrhœa marshalli* flies, *Discophora* ♂♂ become active; they fly fast and high, but seem to come to rest soon and may be caught sitting on a leaf, the rich brown underneath being conspicuous. The ♀♀ are more in evidence during the day, and often flit across glades, and do not seem to fear the light so much as the ♂♂. *Discophora lepida* is to be found above the ghats also, e.g., at Srimangala, and at Irpu, and on the edge of the dry area near Gonicoppal; in all cases in damp spots by streams or in thick swampy jungles. It is about from March to May, September–October, and December–January, and may be in other months.

VI.—Family. NYMPHALIDÆ

F 1. 2β. **Charaxes polyxena imna,** But. 'Fairly common in the evergreen forest (Hannyngton). It is also to be seen in the dry eastern forests; I have seen it near Karke Bridge, between Fraserpet and Somwarpet, at the end of January, and near Titimati on the edge of Coorg in September. That it is not confined to the evergreen forest is proved by the fact that it has been caught in the Lal Bagh at Bangalore. ♂♂ at any rate come down to damp mud or to wet rock. ♀♀ I have only seen on the edge of jungles, into which they slip easily at one's approach.

F 1. 7 β. **Charaxes fabius fabius,** F. 'A rare visitor in the east' (Hannyngton). I record that I have taken it low down on the Periambadi and Sampaje ghats in March. Both captures were made at water. It is certainly much less common in Coorg than the last. Round Bangalore *fabius* occurs prinicpally from August to October.

F 2. 1 α. **Eriboea schreiberi wardi,** M. This butterfly is certainly rare, if not very rare in Coorg: it is even more difficult to catch than it is rare. Hannyngton says he only saw it once in three years on the Periambadi ghat. It flies as a rule very high round flowering trees, but in the hot part of the day may come down. I saw one flying very high round a certain small patch of forest by the river at Urti; it seemed to come back continually to one small tree, but always out of reach. I went the next day between 1 and 2 p.m., and at this time of day, it was flying lower and eventually settled lower underneath a twig, so that I could catch it. In flight and manner of resting it closely resembles *Eriboea athamas*. I have seen not less than a dozen but only captured two, missing—for it is a very wary insect— a couple of others. I got one at Kakkotpole river (Marinad), saw and missed one at Irpu, both above the ghats on the eastern side of the slopes. I have seen it in January, March, April (end) and May. It occurs, apparently, both above and below the ghats in ever-green forest, always so far as my observation goes, in the neighbourhood of streams. [The British Museum has a splendid series from S. Kanara.]

F 2. 2 β. **Eriboea athamas agrarius,** Swin. Common all over Coorg and at all seasons. It has a habit of choosing a bush or tree, or even a leaf of a bush to which and from which it flies. It settles either above or below the leaf. It comes freely to water.

F 6. 8 β. **Apatura parisatis atacinus,** Fruh. It is a matter of chance, I suppose, but my experience was not the same as Hannyngton's: I saw and caught more ♂♂ than ♀♀. The ♂ often sits upright on a leaf at the edge of a tree or shrub, to which, if disturbed, he will fly back. He will come down to mud on a damp road.

F 10. 1 α. **Euripus consimilis meridionalis,** WM. A rare butterfly. Col. Winkworth's experience was the same as Hannyngton's; ♀♀ out number ♂♂. I record my small experience as 2♂♂ : 1♀.

F 18. 3 α. **Euthalia lepidea miyana,** Fruh. Though not abundant, this butterfly is, I think, common throughout the evergreen and intermediate areas; it is almost as common as *E. nais* is round Bangalore. It is a shy woodland insect; haunts the edges of woods into which it slips when disturbed. It seems to be somewhat attached to particular spots: I have noticed that, like *E. laudabilis*, it can always be found again at a spot where it has once been observed. I have never observed it come down to water.

F 18. 10. **Euthalia telchinia,** Men. I did not catch this myself, but I am satisfied of its existence in Coorg. The facts are these. In May 1928, a schoolboy, R. Gilby, of Bishop Cotton Boys' School, Bangalore, was spending his holidays with a brother in S. Kanara about 20 miles from the Coorg border. He bicycled a certain distance into Coorg up the Sampaje ghat to collect butterflies for a school collection, which Mr. C. N. Marcon, a master at the school, was getting together. He brought back from this expedition a number of butterflies, attractive things such as a schoolboy would notice; they were mostly well-known species. Among them was a *E. telchinia* ♂, badly damaged, which I sent to the Society to have my identification verified. The possibility of a butterfly, known hitherto only in N. E. India and N. Burma, being caught in

S. W. India seemed doubtful. I cross-examined the boy, who told me almost exactly where he caught it on the Sampaje ghat; and described its flight as very similar to that of *E. garuda* (which he called green pigeon). He said he saw it was something nice, but had no idea of its rarity. He said he had had no butterflies sent him from the north. The specimen was set by Mr. Marcon and is in the school museum. I see no reason to doubt its capture in Coorg, especially as subsequently, in March and April of last year (1929), having gone to that part of Coorg to look for *E. telchinia* myself, within 30 yards of Gilby's spot I took *Itis microstictum*, W. M. *and Nacaduba pactolus continentalis*, and lower down, within half a mile, in the same forest by the river *Amblypodia abseus indicus*, Riley and *Gerydus biggsii* ♀; none of these had been found nearer than N. East India before. If these, why not the other?

F 18. 14β. **Euthalia garuda meridionalis**, Fruh. All over Coorg, as elsewhere. But in the evergreen country I have seen and caught many more of *E. lepidea miyana* than of this.

F 18. 17β. **Euthalia lubentina arasada**, Fruh. Except *E. telchinia* this is, so far as my experience goes, the rarest *Euthalia* in Coorg. Hannyngton makes no comment; his experience would have been valuable. *E. lubentina* is fairly widespread. I have taken it in N. Coorg (Madapur) and S. E. Coorg (Irpu), and on both the Periambadi and Sampaje ghats. I have seen this *Euthalia* nearer to water than any of the others, but not actually at water; on rocks by a stream, and on a bush above a stream. At Madapur in May 1928, it frequented *Eugenia hemispherica* (?) which was in flower.

F 18. 26β. **Euthalia evelina laudabilis**, Swin. Hannyngton records it from the Eastern forests and the ghats. I have seen it also on the eastern slope of the ghat hills. It seems to prefer forest to woodland. It is partial to certain haunts; each brood inhabits the area inhabited by its predecessors. Hannyngton gives January and September as months for its appearance. I add March, April, May and October as months in which I have seen it and taken it.

This beautiful butterfly fascinates by its assimilation of colouring to surroundings. At a corner of a forest path it flits across, settles underneath a leaf in a bush or tree or on the upper side of a leaf, if the light is not too strong, with wings expanded in the manner of all *Euthalias*, and on one's approach will disappear, its green lost in the green of the forest. It will sometimes fly out for a short distance on the open road to disappear again in the forest. Inside the wood it is almost as hard to follow as *Kallima*. I have often been reminded by it of ' a green thought in a green shade '.

I have seen it near streams and have caught it in a ditch by the roadside, but settled on a leaf not on the ground. I have not seen it settle on mud.

F 18. 27. **Euthalia nais**, Forst. This is a butterfly that seems to like bright sunshine and rather dry conditions. For this reason, I suppose, it does not extend to the evergreen areas. Like Hannyngton I have only seen it in the eastern part of the province in open parkland on the edge of the deciduous forest. It commonly flies rather low and settles on the earth with its wings widespread, brilliant in the bright sunlight.

F 20. β. **Parthenos sylvia virens**, M. A butterfly wholly of the evergreen forests; chiefly of the ghats and the country below the ghats. Like *E. laudabilis* it flies in the shade of the forest, but comes more frequently outside. It settles on flowers freely: at Sullia in S. Kanara in September 1928, I saw a dozen or more after rain at 3 p.m. settled on some lantana by the roadside. It generally seeks cover inside the undergrowth or in the leaves of a tree. I have never seen it settled on the ground at water. The ♂ appears to have a bronze patch on the disc *uhw*.

F 24. 7β. **Liminitis procris undifragus**, Fruh. Flies throughout the evergreen area both above and below the ghats. Davidson and Aitken, quoted by Bingham, say the larva feeds from July to October. Since it occurs also in January and again from March to May, I presume there must be at least two more broods. It likes open glades, road sides and clearings; comes freely to flowers during the day. I have once seen it settled on wet sand at a small stream-crossing at the edge of the forest.

F 25. 2*a*. **Pantoporia nefte inara**, Db.

F 25. 4*α*. **Pantoporia selenophora kanara**, Evans.

F 25. 10*β*. **Pantoporia ranga karwara**, Fruh.

F 14. **Pontoporia perius**, L.

All four, so far as my experience goes, are found only in evergreen forest: they are essentially woodland butterflies, that are generally to be found inside the forest, but come out to feed or to expand their wings and to enjoy for a short time the sunlight on the edge of the forest. Of the four, *Pantoporia ranga karwara* seems to be the most widespread in Coorg; the least frequent is *P. selenophora*. But none of them can be called common. All four are found on the ghats (Periambadi and Sampaje).

F 26. 1*α*. **Neptis columella nilgirica**, M. Not common in Coorg. Found in both the deciduous and evergreen forest. Titimati, Srimangala [Irpu road] and the ghat roads are three typical localities—deciduous, intermediate and evergreen.

F 26. 6*α*. **Neptis hylas varmona**, M. Abundant everywhere.

F 26. 7*α*. **Neptis soma kallaura**, M.

F 26. 8*α*. **Neptis nandina hampsoni**, M.

I am uncertain about these. There certainly seem to be two varieties of one species, if not two species. I have one specimen which closely resembles *N. soma soma* of the books. Apart from other characteristics, this and similar specimens differ from those of the *nandina* type in the narrow and pointed nature of the discoidal streak; the cell streak in these also is less clearly notched than in those I take to be *N. nandina hampsoni*. Yet there is no clear dividing line between the two types. It is difficult to say, after examining Col. Winckworth's specimens as well as my own, where one type ends and the other begins; there are intermediate and indeterminable specimens. I think probably an examination of a long series would show them to be all of one species: and I think only a series of breeding experiments could settle the matter. Whether one species or two, this rare *Neptis* is definitely an inhabitant of the evergreen forest of the ghats and the thick evergreen woodland above the ghats.

F 26. 26*α*. **Neptis viraja kanara**, Evans. This is undoubtedly rare in Coorg and is apparently only to be found in the thick evergreen forest country. I have it from the Periambadi and Sampaje ghats.

F 26. 32*β*. **Neptis hordonia hordonia**, Stoll. Common throughout all areas. Like *N. hylas* it comes more into the open than the other *Neptis*.

F 27. 4*α*. **Cyrestis thyodamas indica**, Evans. Common in the evergreen country, especially near streams. It settles on trees, often under leaves, with either folded or spread wings. Its most characteristic pose, according with its rather flat jerky flight, is when settled with wings spread flat on the ground on damp patches. Fairly abundant, especially before and after the monsoon, i.e., March to May and September to November.

F 30. 1. **Hypolimnas misippus**, L. Common in Coorg as elsewhere. I have not seen ♀ *var. alcippoides*. ♀ *var. inaria* Cr. occurs both in Coorg and in Bangalore.

F 30. 2. **Hypolimnas bolina**, L. More abundant everywhere in Coorg than the last. Commonly on flowers of all kinds. Not taken at water.

F 33. *β*. **Doleschallia bisaltide malabarica**, Fruh. Hannyngton says he only saw one specimen in three years on the Periambadi ghat. I have not seen any. Col. Winckworth caught one at the bottom of the Periambadi ghat in October 1927. It would seem to be very rare in Coorg.

F 34. 1*β*. **Kallima philarchus horsfieldii**, Koll. Well distributed in the intermediate and evergreen areas; both above and below the ghats. D.S.F. appears in October after the S. W. monsoon. This butterfly, though more common from March to October, flies throughout the year. I am told that in August when the jack fruit ripens, it is almost abundant in groves of jack trees, being attracted by the ripe fruit.

F 35. 1 *a*. **Precis hierta, hierta,** F.

F 35. 2 *a*. **Precis orithyia swinhoei,** But.

F 35. 3 *a*. **Precis lemonias vaisya,** Fruh.

F 35. 4 *a*. **Precis almana almana,** L.

F 35. 5. **Precis atlites,** L.

F 35. 6. **Precis iphita pluviatilis,** Fruh. All common ; perhaps the least common in Coorg at any rate in the evergreen area is *P. almana*, and the commonest is *P. iphita*, which is more of a woodland butterfly than the others. *P. atlites* is generally found in the neighbourhood of water—wet paddy fields and streams : it is not apparently found in the dry country of the Mysore plateau.

F 36. 1. **Vanessa cardui,** L. Throughout Coorg as elsewhere.

F 36. 2 β. **Vanessa indica pholœ,** Fruh. Hannyngton considers it a rarity in Coorg and possibly a straggler from the Nilgiris in the cold weather. It certainly is not common but the freshness of the specimens I have seen and the distance of Coorg from the Nilgiris make me doubt his suggestion. It is, as a matter of fact, fairly common at Mercara in November, on bushes of Mysore thorn (*Cœsalpina sepiaria*) and wild bramble near the Mercara Travellers' Bungalow. I have seen it on flowers on the wall from the Commissioner's gate to his bungalow. Another more distant point from the Nilgiris is Bhagamandala.

F 36. 3 β. **Vanessa canace viridis,** Evans. Found in a good many places in Coorg. Generally flies near streams. Has a habit of making short flights and coming back to the same spot—a rock or a bush.

F 41. β. **Cupha erymanthis maja,** Fruh. Common and at times abundant throughout the intermediate and evergreen country. Flies round and through trees and bushes. Settles on various flowers. Not seen at water.

F 42 1. **Atella phalanta,** Drury. Common, but commoner in the drier areas than in the evergreen country. A low flier ; settles on trees and bushes. Not gregarious as the next—at least not in my experience.

F 42. 2 β. **Atella alcippe mercea,** Evans. As noted by Hannyngton, ' decidedly local and gregarious ' on the western slopes. I have seen it once in the eastern forests on the borders of Coorg. It is evidently rapid in development, and there must be almost continuous broods. I have taken the *larva* ¾ grown ; it has developed and completed its growth within 48 hours, and passed through the pupa stage within a week. The small tree *Alsodeia zeylanica* is abundant on the lower part of the Sampaje Ghat, largely as a rather big undergrowth. The larva feeds on the bright green tender terminal leaves ; as one passes through the forest, one hears a continual sound of small things falling to the ground ; these are the larvæ of *A. alcippe* in all stages of development. Attached to the leaves are also innumerable pupæ. At the same time on the road especially where the ground is damp, there are continual clusters of the butterfly, which are so frequent as to be a nuisance ; they distract the eye from other species. I have seen *Atella alcippe* in March and April in literal thousands along a stretch of 1½ miles of road through the forest. [*Alsodeia zeylanica* is in the Coorg language *Okkichelapê* ; the thin branches or twigs are said to be used as switches when driving cattle at the plough.]

F 44. β. **Cynthia erota saloma,** Swin. Chiefly in the evergreen country : most common on the ghats. Very easily taken on flowers. Not seen at water. The D.S.F. of the ♀ is of a distinctly lighter shade than the W.S.F.

F 45. 4 β. **Cirrochroa thais thais,** F. Common in the intermediate and evergreen areas in glades, on trees, and at flowers. Apparently at all seasons.

F 47. 2 β. **Cethosia nietneri mahratta,** Fd. Throughout the intermediate and evergreen country, but most frequent on the ghats. Flies in glades and on the edges of the forest. Not taken at water.

F 48. **Byblia ilithiya,** Drury. Rare in Coorg. I have never seen it. Col. Winckworth took one specimen at Urti. Where it occurs round Bangalore at special spots, it is fairly abundant. Taken from July to January on tank bunds, in gullies and round bushes.

F 49. 1 α. **Ergolis ariadne indica**, M.

F 49. 2 β. **Ergolis merione merione**, Cr. Both are common. Of the two *merione* is the commoner. Caught on flowers and on leaves of bushes.

F 52. **Telchinia violæ**, Fab. Throughout the province. Flies low over grass, settles on low bushes and flowering plants.

VII.—Family ERYCINIDÆ.

G 1. 2 α. **Libythea lepita lepitoides**, M. Included by Hannyngton. I have not taken it.

G 1. 3 β. **Libythea myrrha carma**, Fruh. Throughout the province, common. Especially favours roads, damp spots, and sandy spits in river beds.

G 4. 5 α. **Abisara echerius prunosa**, M. Very common. Usually in the day-time flies inside woods; at dusk flies in the open; two may be seen chasing each other round and round in rapid flight. At dusk freely settles on twigs and leaves in the open.

(*To be continued.*)

THE PANTHER AS I HAVE KNOWN HIM.

BY

Lt.-Col. A. H. E. Mosse, I.A., F.Z.S.

PART IV.

(*Continued from page 693 of this volume*)

Apart from rare casual meetings, daytime experiences with the panther are, in the country of which I have most knowledge, usually associated with beats. Unless, however, there are some special features most accounts of beats are apt to read much alike. I shall therefore only refer to one or two.

One beat, a good many years ago, when most of my experience was still to gain, provided me with one of the shocks of my life and taught a salutary lesson. The actual beat itself was perfectly straightforward and calls for no remarks. The panther, a male of medium size, gave me an easy broadside shot trotting past at about thirty yards distance. Unfortunately, I held a little too far forward and he went on with a broken shoulder, getting away into a jungly hillside where the density of the cover varied considerably.

It simplified matters somewhat that I had been able to see definitely that the near shoulder was broken; with a wound of that type he would not go far, and after half an hour—a longer interval would have been wiser—I followed him up. Within two hundred yards he was tracked into some long grass. Stones thrown into this produced no effect, but a man in a tree thought he could make him out. So I climbed up; but just as my rifle was being handed to me there was a commotion in the grass and the panther streaked out on the far side and disappeared. On following again, a scout in a tall tree said he had seen the panther go up a wide sandy nullah straight ahead of us until it turned a corner to the left, round which he went. The corner of the nullah was some one hundred and fifty yards ahead. I knew the spot and that the nullah further on was full of thick *korinda* bushes, for the shelter of which, I made up my mind, the panther was making.

This side of the corner then, it seemed there could be no danger and for the moment my vigilance relaxed. The trackers started along the nullah. I, for no particular reason that I can remember, left them, taking a line of my own some twenty yards to the left, where the ground was fairly open, but intending to rejoin them before reaching the corner. However, when I had covered about fifty yards I came to a patch of grass perhaps a foot high and five feet square, in which was growing a bush about the size of a gooseberry bush. I brushed against this in passing and my heart was in my mouth ! for with a startled 'wough', from under my feet sprang the panther, upon which I had all but trodden; I nearly jumped out of my skin! Before I had recovered myself he was out of sight behind some bigger bushes. My escape from disaster was probably due to the fact that the trackers in the nullah, twenty yards away, thinking, as I did, that the beast was nowhere near, were talking, and the panther listening to them had not noticed the silent approach of my hemp-soled boots: he was therefore as much taken by surprise as myself. Half an hour later we found him again in a patch of high grass on a steep hillside. I was reconnoitring this, from above as one should always do, when out he came straight at me. With his broken shoulder, however, the hill was too much for him, and he swung round again just as I fired, missing clean. Again he was marked down under a thorn-bush, where I could not make him out clearly and hit him, as it turned out, too far back. He was able to get away, very sick, but at length the end came with a gallant charge stopped by a bullet in the brain at about five yards distance. An easy shot, for, though he meant business, he had not the strength to put much pace into his effort.

In this case there can be no doubt that I should have been in for serious trouble, had the panther not been taken by surprise owing to his attention being fixed on the trackers. Why he had turned back after rounding the corner of the nullah, instead of proceeding on to the thicker cover ahead is more than I can guess. But the moral was clear—never to think one knows with certainty what a panther will do in any given circumstance. Another lesson was never to allow any chattering within possible hearing of a beast, except when absolutely necessary and then only in a whisper, though, to be sure, it was probably the breach of this rule that saved me!

Here is an example of the element of luck that obtains in all *shikar*. A panther in a beat succeeded in passing my *machán* unobserved and then took refuge in a cave, from the shelter of which nothing would move her. We tried to smoke her out but without success. At length, a last resource, I fired a shot straight into the darkness of the cave, hoping that might bring her out: but there was no result and I had to give up. One of my men however offered to spend the night in an adjacent tree watching to see if she emerged before morning. Soon after sunrise he turned up at my tent with the news that the panther had been moaning as if in pain at intervals during the night, that she was still in the cave, and, what was more, that she was now close to the entrance and just visible. I hurried off to the place, crept quietly up to the cave rifle in hand, and peeping carefully round a rock was able to make out, indistinctly but undoubtedly, the spotted skin of the panther lying a few yards away. Slowly I raised the rifle and fired, springing back on the instant behind my sheltering rock. Nothing moved, and soon we had the dead panther dragged out. She was stiff and cold, having evidently been dead for some hours! My random shot of the day before, fired with no intention but that of rousing her, had found its billet in the centre of her body. It was a remarkable fluke!

Sometimes the luck is with the panther, as on one occasion when an easy shot at a particularly fine animal trotting quietly past only twenty yards away, resulted in a misfire! Twice I have been beating for a tiger when a panther approached and offered an easy shot, but was allowed to go unharmed for fear of alarming the nobler game. On neither occasion did the tiger put in an appearance at all.

An unwounded panther will rarely charge unless cornered; the following incident was perhaps one of the exceptions that prove the rule. I had been shooting one afternoon, and was on my way back to camp, when a man came up to say he had just seen a panther go into some bush in a river-bed close by. This bush extended for two or three hundred yards, then came to an end. The banks were comparatively open but on the right bank further on was some thick jungle. There was no convenient tree and no time to construct any sort of shelter, so I took up my position on this bank behind a bush, and sent the men collected from an adjacent village to beat the river-bed from the other end of the cover. I was armed with a single-barrelled ·450 Express rifle, and had with me an orderly carrying a 12-bore shot gun loaded with ball. I had a 'stop' posted in a tree to the left to turn the panther if he should make in that direction.

At length the panther appeared at the edge of the cover in the river-bed, then crept quietly up the bank and stood fifty yards away, directly in front of me, and looking towards the jungle at my back. He apparently came to the conclusion that the way was clear, for he started forward leisurely enough and in a few seconds more would have offered me a perfect shot. Unfortunately, the man in the tree to the left had seen him, lost his head, and emitted a yell. Instantaneously the panther turned and was back in the river cover again. Closer came the beaters, making a tremendous shindy, but for half an hour the panther declined to stir; at last he came with a rush, some forty yards to one side. From this point I was not entirely hidden by my bush; he spotted me, checked for a moment, and then, instead of keeping his line for the jungle beyond, turned and charged straight at me. If I had had any anticipation of this sort of thing the 12-bore would have been in my hands, not the ·450: however there was no time to change now, and as I had only one bullet on which to count, I had to try and make sure of my shot by letting him come as close as might be before firing, and trust to my orderly in case of accident. The panther covered the intervening space in a minimum of seconds. He was perhaps ten or twelve paces away and I was on the point of pressing the trigger, when suddenly he swerved to the right and went past me like a flash. I swung round and fired a broadside shot at about three yards distance and never touched him! To say I was disgusted would be putting it mildly, but, after all, my rifle-shooting had never included practice at a lightning-flash!

That panther had had ample cause for losing his temper; he may have meant to charge home when he first saw me, but thought better of it when nearer approach shewed there were two of us, and that we did not give way. But my own impression is that he was merely bluffing.

I can however give one instance of an apparently unprovoked attack. One afternoon two men, Thakardas by caste, came into my camp, one a youngster of eighteen or so, rather badly mauled about the right side and arm. Their story was that they were occupied in cutting wood, at about mid-day, when a panther suddenly sprang out upon them, and seized the boy by the right side, below the arm-pit. He said that he then seized one of the panther's ears with his right hand, and with his left its lower jaw, while the other (his elder brother) sprang astride the panther's back and smashed its skull with a blow or two of a heavy stick! It sounded a tall yarn, but they were so matter-of-fact about it that I have no doubt it was quite true. I sent out a couple of men with the uninjured brother and they brought in the dead panther—a rather small female—with a broken skull, but no other sign of injury. This attack was a remarkable one, but probably to be accounted for in one of two ways. The panther may have had a young family near by (though no trace was found of any), or she may have been in some manner taken by surprise and thought she was attacked.

I once witnessed an example of the speed of a charging panther which afforded as narrow an escape from a 'nasty mess' as I have any desire to see. I had a shot on foot at a panther bounding away at about thirty yards distance and hit him, as afterwards appeared, in the hind quarters, the bullet raking forward. He fell and lay struggling. From his movements I thought his spine was injured and that he was therefore helpless, so fired my second barrel at his head to finish him off. Just as I pressed the trigger he made a snap at his wounded quarter and I missed. At the sound of the shot he looked up, and in a moment, for his spine was not injured, was charging straight for the first man he saw. This was a Rajput shikari who had come up unknown to me, and was standing where he had no business to be, about twelve yards to my left. I dropped my rifle and snatched another from the orderly at my side, but before it reached my shoulder that raging living thunderbolt was on the shikari and down went man and beast together. Then occurred a remarkable incident. The shikari was wearing on his head a *pagri* consisting of many folds of a mixture of silk and cotton, a fine but very tough material; this was not merely wound round his head but was in some way fastened to his hair. As he fell the panther struck with both paws at his head. Result, that the next instant the spectacle was provided of the man on his back and the panther on top, striving, for the moment unsuccessfully, to release its claws entangled in the *pagri's* clinging folds! It was ludicrous if one had had leisure and inclination to laugh. There was just time however to run up close and put in a finishing shot, before the panther, not a large one, could do any damage. The dead beast was pulled off, and the shikari picked himself up quite unperturbed, true Rajput that he was, and none the worse except for a single scratch on the back of his hand. Of course he would not have escaped so lightly but for the fact that the panther's first wound was a mortal one and the effort of the charge had absorbed most of its failing strength. Nevertheless had that first blow been three or four inches lower, the whole front of the man's face would probably have been torn down by those deadly claws.

Though essentially a nocturnal animal, the panther now and then begins his hunting some time before sunset or continues it after sunrise. But you will very rarely meet him. With his quickness of sight and hearing he will invariably detect you first and unless he chooses to be seen you will not see him. One of the rare occasions on which I have met a panther casually in the daytime when not looking for him is worth recalling. It was near Himatnagar in the State of Idar. I was encamped there shortly after the installation, at which I had assisted, of the then Maharajah, that grand old Rajput sportsman Sir Pratap Singh. On the river close by was a charming waterfall, the face of which, wherever the flow was not too strong, was covered with maiden-hair fern. At the foot of the fall was a deep pool perhaps twenty yards in length, which at that time was inhabited by a small *mugger* and was known to us accordingly as the Mugger Pool. I never saw more than the nose or top of the head of this *mugger* but judged him to be not more than three or four feet long, and therefore no obstacle to a swim. The delight of those early mornings in the hot weather! A plunge in that beautiful cool water, a swim round, and then to clamber half out and sit amidst the delicate green of the maiden-hair beneath and surrounded by the silver cascades of the most perfect natural shower-bath; what mattered the burning hours of the day to follow, grilling in an office tent—the present was bliss! It was on such a morning that I was striking across the pool, heedless of the *mugger's* rights, when I happened to glance up towards the rocks above on the far side, and gasped! For there, some fifty or sixty yards above me, on his haunches sat a panther surveying with interest this new white *mugger* or whatever it was that the water had produced. I wished afterwards that I had stayed in the water to see if he would come nearer to investigate; but I was taken by surprise and my only thought was to get back into my clothes and then to the sowar who had my gun with my pony not far off.

When he saw me out of the water on the opposite bank, the panther stood up, looked at me for a moment or two, and then walked leisurely away. Later we tried to track him up but without success. It was extraordinary his being there, three or four miles from the nearest cover, so late in the morning, for it must have been two hours after sunrise. Looking back, what seems so ridiculous is that I felt extremely uncomfortable at being seen in a state of nature—by a panther! I can't explain why: if one had to come to an unduly close acquaintance with a panther's claws, one might almost as well be without any clothes for all the protection they would afford.

We all know the weasel's reputation for not being caught napping, but how many people have caught a panther asleep? I was once just on the point of starting on a twenty-mile ride to catch a train, for a few days' leave in the hot weather; when *khabar* came in of a panther in a small nullah, two or three miles distant and not out of my way.

A villager had noticed the fresh tracks and with an eye to possible *bakshish* had followed a short distance and actually found the panther asleep. He took me straight there trotting beside my pony until it became advisable for me to dismount. There was no time to collect beaters, and the chances were all in favour of the panther's escape once he was roused, so I determined to try and stalk him as he lay. My guide led me to where the nullah was narrowest, creeping up behind a thick *bher* tree growing out of the grass. On the far side he said the panther was lying. With the utmost caution I parted the cover sufficiently to study the opposite bank about seven or eight yards away, and after two or three minutes' inspection distinguished a patch, about twelve inches by six in area, of spotted skin, in a slight hollow under the top of the bank behind some bushes and long grass.

I could see nothing of head or limbs, and saw no possibility of obtaining a better view from any other spot. Besides, I dared not move again, so took the risk and fired. A very slight convulsive movement and that was all; with great luck my bullet had found his heart. Unsporting? Well : from one point of view, as I have said before, panthers are vermin and one need not be over-scrupulous as to one's methods of destroying them. On this occasion there was no time for any other plan and I had hardly expected to be able to make such a successful approach. Then my shot was an extremely fortunate one, for I had no certainty as to what part of the body I was aiming at. If it had been a few inches further back, the wound would probably not have been immediately fatal or disabling, and close as I was to him it might very well have then been the panther's turn. Moreover, to clinch the matter, there was at the time a man-eating panther in the district and, though there was no conclusive proof of identity, there was some reason for thinking that this might be the criminal.

I think the unexpected incident which stands out clearest in my memory is that of my first meeting with that rare beast, the black panther. It was in the Nilgiris where, of course, the occurrence of melanistic specimens of the panther is less infrequent than is the case farther north. I had been doing a morning prowl in the hope of finding a warrantable sambur stag keeping later hours than usual, but without success. Strolling leisurely back towards my camp, I heard the swearing of a party of the black langur monkeys of the Nilgiris coming from an adjacent *shola*—as the patches of thick cover are called which clothe the hollows and parts of the slopes of hills on the high Nilgiri plateau. I had no doubt that the commotion was due to the presence of one of the big cats. The *shola* was quite a small one separated by a strip, some forty or fifty yards wide, of open hillside, from another and much bigger *shola*. This fact seemed to offer a possibility of inducing the unseen beast, tiger or panther, to move to the more secure shelter of the larger cover.

I therefore sat me down under an isolated small tree between the two *sholas* and sent my two men to walk through the small *shola* from the far side. The scheme worked according to plan. Not five minutes had passed when there sprang out from the lower end of the *shola* a *black* panther ! With the sun shining on his coal black hide, he presented a beautiful picture of graceful movement as he proceeded in great cantering bounds towards the cover beyond while I missed him clean with both barrels ! A trotting panther maintains the same level and is an easy mark, but when he bounds it is another matter. He was a hundred yards away ; so, at that gait, there was a measure of excuse for my failure ; but it was a great disappointment.

Three days later and over a mile away, time about 9 a.m., a black something caught my eye on the far side of a wooded ravine. Putting my glasses on to it, I recognized my friend again, this time in the company of an ordinary yellow panther who, to the naked eye, had not been visible. It took me some half an hour to get to the other side of the ravine, by which time the black panther had disappeared, though his yellow mate lay basking on a rock. I did not disturb her.

Early in the afternoon I was out again lying in wait. I had not been able to procure a goat. After a while the monkeys gave warning of some beast on the move and presently the yellow panther emerged from cover two hundred yards away, but though I waited until dark the black one did not appear again.

As I have said, in the Nilgiris the black panther is not so great a rarity as farther north. I had never heard of one in Gujarat. However, in the year 1924, I was encamped in a jungly district of the Idar State. There were panthers about but I was occupied with a Border Court and had not attempted to make their acquaintance. The work of the Court finished, I spent my last afternoon on a visit to a Bhil Mission Settlement some miles away. Returning home I was within half a mile of my camp just before sunset when I saw a black dog, as I thought, cross the track one hundred yards in front of my car, and halt on the bank at one side. When within fifty yards it dawned on me that this was no dog but a black panther of moderate size ! I immediately stopped the car and got my rifle out of its cover, but before I could load the beast decided to move on and with a graceful bound disappeared in the jungle adjacent to the track. This was a great surprise, rather exasperating too to think that, had I tied up for him during the week I had been there, I might well have got him. I could not postpone my departure and was unable to visit that neighbourhood again before leaving the district for good.

It will be noted that it was his colour which enabled my eye to pick up that Nilgiri specimen at a distance. And at closer range, under conditions of light when an ordinary panther, if motionless, would be more or less invisible, a black one would almost always be conspicuous. To what extent this conspicuousness actually handicaps the animal in capturing its prey is problematical. That it does so to a certain extent it seems reasonable to suppose, but I fancy the handicap is less than one might imagine owing to the success with which any creature that keeps still can avoid detection in the jungle. Another factor that may have some importance is the rarity of the black panther ; the deer tribe in India have ordinarily no occasion to associate black as a colour with a four-footed foe.

while their curiosity at sight of an entirely strange object is sometimes liable to lead them to destruction.

The panther's occasional practice of hiding his 'kill' for safety up a tree is well-known. Also that he will sometimes lie in wait upon a branch above a game track. I am sure too that during a beat he will often seek refuge within the concealing foliage of a thick tree. I have, however, actually seen a panther in a tree on three occasions only. A goat killed by a panther was on one occasion dragged the remarkable distance of three-quarters of a mile and hidden under a bush at the foot of a thick foliaged evergreen tree known in Gujarat as the *rhain*. One of two men sent out at midday to construct a hide came back with the news that, while studying the *rhain* tree as to its possibilities for a *machán,* they had detected the panther itself well hidden in the heart of the tree. I set forth at once, to be informed by the second man who had remained on watch that the beast had not moved. At a distance of forty yards, even with the glasses, I could see nothing. It was only after I had approached with circumspection to within twenty yards that I was able, with the aid of the binoculars, to distinguish just the round head of a panther looking lazily at me from a height of about eighteen feet and obviously quite satisfied that it was entirely concealed from view. I removed the glasses from my eyes and could see nothing. Putting them up again I took note of a conspicuous yellow leaf exactly above his right eye which afforded a definite point of aim. I felt certain I could make sure of the brain at that distance. Aiming accordingly, I fired; there was a convulsive struggle or two and all was still. The glasses showed the body hanging across a branch head downwards; he was obviously dead. Imagine my disgust on getting him down to find that my victim was a poor little half-grown cub, four or five months old! Viewing, as I had done, the head through glasses only I had not realized its small size. It had not occurred to me to suspect the presence of cubs, of which the tracks had not been noticed though, wise after the event, I now understood that the mother had dragged her kill that unusual distance in order to bring it near to the spot where she had left her children. I saw the mother, rather a large female, with a second cub later, but did not interfere with her as the cub was hardly large enough to shift for itself.

I have already mentioned a female panther which climbed into a tree so as apparently to keep an eye to the proceedings of her youthful son who was about to try and make a kill. I do not think I can bring my stories of the panther to a better conclusion than by giving an account of my third experience of a panther in a tree—an incident which for me shed a new light upon the panther's intelligence.

It was among the hills of Northern Gujarat. I had two beats one morning in the hot weather for a panther of no great size: on each occasion she contrived either to break back through the beaters or to sneak past one of the stops. Each time she was marked down again—an unusual piece of luck. The third time was on a hillside overgrown in parts with long grass, in parts with bush of varying thickness, and dotted all over with a number of trees. I took post in a tree at the foot of the hill and the beat started from above down towards me.

About five minutes after the commencement, the beaters were still near the top of the hill when, about half way down, some ninety yards away from me, the panther suddenly appeared leaping up on to the trunk of a tall tree, bare of foliage, which stood out prominently among its lesser neighbours. Leisurely the great cat climbed towards the summit, and there in the highest fork sat down to watch the advancing line of beaters. For four or five minutes she studied the numbers and dispositions of the enemy, then, having learnt all she wanted to know, proceeded to descend again, leisurely as before and disappeared in the long grass below.

A friend to whom I told the story remarked: 'Of course she climbed the tree in search of a hiding place'. She did nothing of the sort. No panther's instinct would lead it to try and hide in a leafless tree that obviously afforded no cover whatever, and that when there were actually two other trees with abundance of foliage within a few yards. This panther had been twice disturbed by the beaters: now when she heard the sounds of their approach again she selected the most suitable tree for her purpose and went aloft to reconnoitre. Her deliberation was most marked. Here was no working of that mysterious faculty we call instinct, but an action—or rather a series of actions—of definite intelligence, the outcome of some degree of conscious thought. No man who watched this beast's behaviour as I did could possibly believe otherwise.

And so much for the panther as I have known him.

THE BULBULS OF THE NILGIRIS.

(*With 2 plates.*)

BY

F. N. Betts.

The Bulbul family, the *Pycnonotidæ,* is well represented on these hills. From the plains level to the summit of the highest peaks, in the heart of the towns or the depths of the jungle, members of the clan are always in evidence and their cheerful voices provide a very large proportion of the bird music that falls upon the ear.

Six species have been recorded from the district, of which four are common and two rare, and it is unlikely that any others occur. They are all arboreal in habit and seldom come to the ground except to gather nesting material and when they do their weak, short legs will hardly support them and they shuffle about in a very awkward manner. As a family they are catholic in their feeding habits. Whilst some species are almost entirely frugivorous, most of them consume large quantities of insect food and are always ready to turn fly-catcher especially when a flight of termites is in progress.

Though none of them have any song, properly speaking, yet their calls are usually tuneful and always light hearted and even the Black Bulbul whose voice is harsh and raucous seems inspired with such sheer exuberance of spirits that one can forgive its discordance.

By far the most familiar of them all is the Red-whiskered Bulbul, *Otocompsa emeria fuscicaudata.* It is probably the commonest and certainly the most conspicuous bird on the Nilgiris at all elevations. Tame and confiding to a degree, it delights in gardens and cultivated country but is equally common in open scrubby jungle, though it avoids heavy forest and the bare, treeless, grass downs of the plateau. Though not strictly speaking gregarious, loose flocks of considerable size are often to be seen after the breeding season, but, if carefully watched, these will be found to consist of a number of independent pairs. They do not seem to wander a great deal and each pair usually remains in the neighbourhood of its breeding haunts throughout the year.

This species is quite omnivorous and plays havoc with fruit in gardens and has a playful habit of pulling up the most valuable of the seedlings which the 'mali' has just put out in the flower beds. It however consumes a great many insects, many, no doubt, harmful which must be put to its credit. It not infrequently comes to the ground to feed, but it is by no means at home there. At times especially in the evening, it will try its skill at fly-catching, darting out from some outstanding twig and displaying considerable dexterity though it is not such an adept as the Black Bulbul.

It is a noisy bird and has a variety of calls. The one which seems to correspond most nearly to a song is a rollicking phrase sounding like 'The Rice must be finished off'. In the breeding season the males may often be seen posturing before their mates with drooping, quivering wings and tail, repeating this sentence over and over again, evidently under the impression that they are songsters of the highest order! The alarm note is a harsh 'lerrrr'. This is employed when the nest is approached or when there is a hawk or owl in the vicinity and it may often be heard in the evening when the birds are going to roost and each seems to feel it incumbent on him to scold at the top of his voice by way of a goodnight, just as the English blackbirds scream and cackle in the shrubberies at dusk.

The nesting season is prolonged and stray nests may be found in any month, but the main period is from February to June and again in September after the South-West monsoon.

The nest is a shallow and usually fairly neat cup of twigs and dead leaves bound with cobwebs especially round the rim. The lining is nearly always roots and dead grass, but I once found one lined with hair. Almost any site may be chosen but it is seldom far from and is sometimes actually on the ground. The most usual situation is in some low bush or evergreen shrub, or in a creeper growing up a wall or verandah. It is usually fairly well concealed and, where the birds breed in big patches of *Lantana* or other scrub, may be quite hard to find. In gardens and where cover is scarce, any bush that provides some sort of shelter is certain to be occupied. The highest nest I have ever found was some fifteen feet up at the end of a branch of an isolated Blackwood tree; but this is out of the ordinary. The birds are very faithful to their favourite site. One pair always breed every year in a bamboo just outside my bungalow. This year they had a nest there with two eggs early in March which successfully hatched after eleven days' incubation. They were very circumspect in approaching the nest and I never saw them building. The hen, presumably, sat very close and would allow me almost to touch her before flying off. Both birds fed the young and seemed to bring nothing but flies and caterpillars. I have seen fledgelings, however, given *Lantana* berries. Unfortunately, these young disappeared after a few days, a crow being almost certainly the culprit. Nothing daunted, the Bulbuls built another nest a fortnight later in just the same spot, but again disaster overtook them, after which they gave it up and built in a small Dadap tree some thirty yards away.

In this part of the world the normal clutch is two, three being rare, and a bird in my garden is at the present date, June 18th, sitting on a single egg—probably a third or fourth brood. The eggs vary a good deal both in size and colouring, but in this district there appear to be two main types. The commoner is pinkish in ground colour, heavily freckled and mottled uniformly all over with small spots and speckles of various shades of purple and reddish-brown so that the ground colour is hardly visible. In the other type, the markings are a beautiful, rich, mahogany-red with no purple or pink at all and so heavy as almost to obscure the white ground colour.

Common and tame as they are, I have not found them easy birds to photograph. Building a hide and clearing a view for the lens always attracts the crows and in the more open situation the nests are time and again robbed before one can get any pictures. When the nest is in a thick bush, the birds have a most annoying habit of creeping up from behind and carefully keeping the nest between themselves and the camera, so that all one sees is a head. Plate No. 1 took three hours to obtain. The nest contained young and I had put up the hide some days before, so that the parents were quite used to it but they were very shy of the lens and absolutely refused to give a good pose, creeping up from behind to feed the young and showing the greatest alarm at the sound of the shutter. Finally however one of them settled down to brood and became as bold as she had hitherto been timid. Nothing seemed to disturb her, neither the shutter nor the noise of changing plates. She allowed me to take a second exposure without the slightest movement and only flew off upon my emerging from the hide.

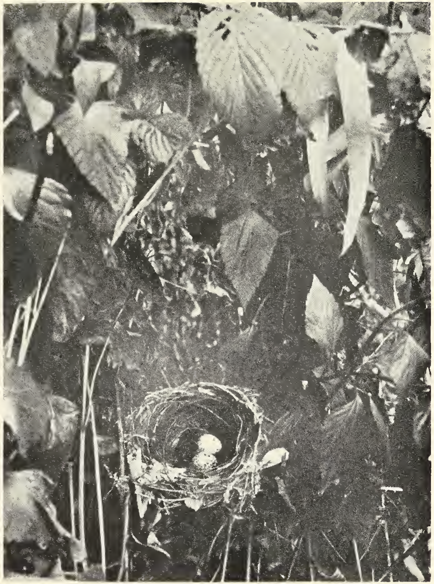
This species is unmistakeable for any other. It has a black head with a long pointed crest jutting forward like Punch's cap and only depressed in flight or when sitting on the nest. The patches of crimson on the cheeks and vent, the white throat and underparts and the incomplete gorget of brown on the breast are all quite distinctive.

The young birds on leaving the nest lack the red on the cheeks and vent and their crests are very short, but they quickly put on mature plumage and do not stay with their parents for more than a few weeks.

The Madras Red-vented Bulbul, *Molpastes cafer cafer* is very similar to the last species in all its habits, but in this district is not nearly so common or widely distributed. It is a bird of lower elevations. Davison obtained a straggler, near Ootacamund at 7,000 feet, but this is most unusual. According to him, it begins to become common just above Coonoor at about 5,000 feet and is very common all down the Eastern slopes. On the Western side, I have never seen it above 4,000 feet and it is nowhere very common. Even at the foot of the slopes on the Wynaad plateau, it is not numerous anywhere south of Gudalur. From Gudalur northwards, however, it increases in numbers till it becomes the common species on the Mysore plains. It is restricted to drier country and will never be found in heavy forest, preferring open parkland, light deciduous jungle, gardens and cultivation. It is not a gregarious species and is nearly always to be seen in pairs. It feeds on the ground occasionally and consumes a large variety of insects, seeds and berries and, like the Red-whiskered Bulbul, can be very destructive in gardens. The nest is indistinguishable from that of *Otocompsa emeria* and is built in just the same situations; but the eggs, which vary considerably, are of quite a different type, being much more boldly and sparingly marked.

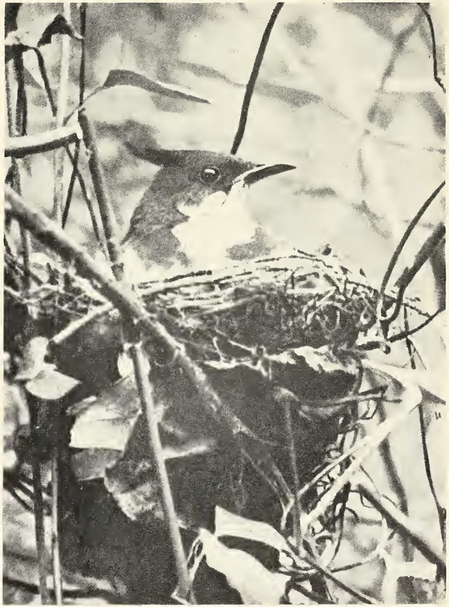
The Madras Red-vented Bulbul has a black head with short bushy crest, dark brown upper parts with lighter fish-scale markings, sooty breast, white rump, crimson patch on the vent and the white tips to the tail feathers.

The Black Bulbul, *Micrscelis psaroides ganeesa,* is purely a hill species, and does not occur much below 4,500 feet except as a scarce wanderer in the cold weather. Above that level, however, it is extremely common. It is a very different bird from either of the last two species, being entirely arboreal and keeping very much to the tree-tops, seldom descending even as low as the undergrowth.



NEST OF RED-WHISKERED BULBUL.

(*Molpastes cafer cafer.*)



RED-WHISKERED BULBUL ON NEST.

(*Molpastes cafer cafer.*)

The borders of the hill sholas are its favourite haunts and there it will be found in flocks of considerable size whose members play follow-my-leader from tree to tree and make the air ring with their harsh cries. Untidy-looking birds, clad in rusty black with a short ragged crest and red legs and beak, their slightly forked tails give them a faint resemblance to king crows. Certain jungle trees in the fruiting season attract large numbers and they are also very fond of visiting the flowers of trees like the Coral Tree (*Erythina*) though, whether they come for the honey or the insects attracted thereby, it is hard to decide. They are the strongest fliers of the family and are expert fly-catchers. In the non-breeding season large flocks collect and though not strictly migratory, they wander a great deal at this time. They desert the western side of the hills almost entirely during July and August when the South-West monsoon is at its height. Like most Bulbuls, they are very pugnacious especially in the breeding season when the males fight fiercely and they will defend their nests boldly against all intruders. They are extremely noisy creatures and have a large number of calls all loud and strident, the commonest being a long-drawn squealing 'weenk'. The neighbourhood of a nest is often betrayed by the scolding and cursing which goes on as one approaches it.

Though they are not birds of the garden, they are by no means shy but they seldom breed in the neighbourhood of houses or villages. The nesting season lasts from March till May and several broods are reared. The nests are always at a considerable height from the ground, anything from fifteen feet upwards.

They are particularly fond of the rather stunted trees standing apart at the edge of the forest belt where the grassy slopes of the higher hills begin. The nests are built in a horizontal fork, usually at the very top of the tree or at the end of an outlying branch, and are neat, shallow cups of dry grass and leaves with a good deal of moss, lined with rootlets or fine grass. The eggs are almost invariably two in number and are very handsome, white or pinkish in ground colour, heavily clouded and spotted with brownish red and purple, but never to such an extent as to conceal the ground.

The young birds resemble their parents and soon leave them to join the main flocks which even in the breeding season do not break up entirely.

The Yellow-browed Bulbul, *Iole icterica,* is a forest species which does not occur above about 4,500 feet and is almost confined to the heavy evergreen jungle which covers so much of the slopes of the hills. In its normal habitat, however, it is very common. It is usually to be seen in pairs and appears to be purely frugivorous. Even the young when quite small are fed upon berries and matter regurgitated from the parent's crop. One pair that I observed brought berries up to nearly ¼ inch in diameter. These were not given at once, but held in the old bird's beak whilst the youngster pecked and pulled apparently until the skin was broken. When it was finally given, the old bird put its beak into the chick's throat and removed the stone. Normally they are rather shy but I have found them the easiest of birds to photograph. I put up my hide within three feet of one nest and had hardly entered it before the birds were back brooding and feeding the young with the greatest confidence and taking no notice at all of the lens or the noise of the shutter. Unfortunately for photographic purposes, the nests are nearly always in dense, dark forest where the light is very poor. They are placed in small saplings or evergreen shrubs among the undergrowth. In this district, in nine cases out of ten, the nests are in the laurel-like shrub shown in the photographs. They are not particularly well concealed and are very distinctive, being shallow cups made almost entirely of green moss bound with cobwebs and lined with black rootlets and always slung in a horizontal fork. The eggs, two in number, are unlike those of any other Bulbuls. They are white, heavily spotted and spotted with small reddish spots and have none of the purple shades so common in the eggs of this family.

Yellow-bowed Bulbuls are handsome birds with their bright yellow foreheads and underparts and olive-green wings and backs. They have sweet voices with a number of mellow whistling notes, though the alarm call is somewhat harsh and jarring.

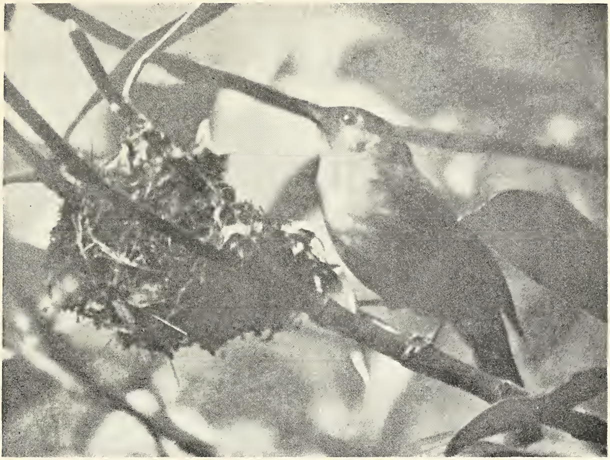
The remaining two species are both rare forest birds and are only found at comparatively low elevations.

The Ruby-throated Bulbul, *Pycnonotus gularis,* is a strikingly handsome little bird, with a black head, yellow eye, crimson throat and sulphur yellow underparts, the remainder of the back, wings and tail being olive-yellow. They are small birds for Bulbuls and are extremely shy inhabiting the thickest jungle, especially brakes of *Lantana* or thorny bamboos. Here they go about in small parties, usually very silent, though a low, churring call note may sometimes be heard. In the breeding season they have a delightful little tinkling song far above the average performance of the family. They are largely insectivorous and spend most of their time diligently searching the trees for their insect food. They never come to the ground. In this district the only place that I have seen them is at the foot of the hills in the Ochterloney Valley, in old bamboo jungle now entirely overgrown with *Lantana.* I have never found the nest, but it is said to be of the usual type, a small cup of dead leaves bound with spider's webs, and lined with a few roots and grasses and placed in low bushes in heavy forest, never in the open.

The Gray-headed Bulbul, *Microtarsus poiocephalus,* has only once been recorded from the district, Davison obtaining a specimen near Coonoor. It will probably be found to occur, however, not uncommonly, on the forested slopes below 3,000 feet at any rate on the Malabar side. It is a shy and unobtrusive species usually found in small flocks among the tree tops in swampy jungle. They are entirely arboreal rarely descending even to the undergrowth and seem to be mainly insectivorous. They are fairly noisy birds, continually uttering a long-drawn wheezy note which seems to be their only call.

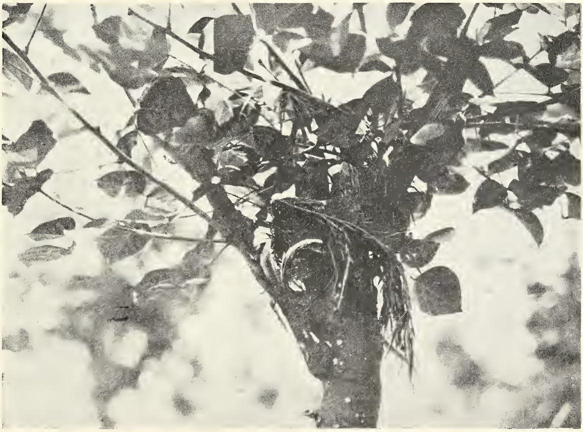
They are soberly clad in dull green and grey. In the field the most distinctive features are the clear grey rump and tail, the latter bordered with black. The white iris is also conspicuous.

The nest according to the *Fauna* is a small, compact cup placed in low bushes in heavy jungle. The eggs number two, or not infrequently one only.



YELLOW-BROWED BULBUL AT NEST.

(*Iole icterica.*)



NEST OF YELLOW-BROWED BULBUL.

(*Iole icterica.*)

NOTES ON INDIAN THYSANOPTERA WITH BRIEF DESCRIPTIONS OF NEW SPECIES.

BY

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Madras Agricultural Department.

(*With 2 plates and a text figure*).

This paper is intended to be the first supplement to a Memoir * on Indian Thysanoptera published by the senior author in 1928. As mentioned therein further collections of Indian forms were made since then and portions of the material worked out from time to time. In this short paper eleven new species including a new genus are described ; in addition a few fresh records for India and available notes on already noted species are also added.

The new forms noted are the following :—

Erythrothrips asiaticus. n. sp.
Æolothrips pandyani. ,,
Mymarothrips garuda. ,,
Dendrothrips dwivarna. ,,
Heliothrips kadaliphila. ,,
Fulmekiola indica. n. sp.
Scolothrips asura. ,,
Oxythrips hemavarna. ,,
Haplothrips tirumalraoi. ,,
Euoplothrips malabarica. ,,
Euryaplothrips crassus.
(new gen. and sp.)

Erythrothrips asiaticus, n. sp.

Macropterous female.—Length, 1·520 mm. General colour, greyish to dark brown with reddish pigment here and there. The head, mouth-cone, the first two antennal joints, the dorsal aspect of the head and prothorax and all the femora dark grey ; abdomen and pterothorax light grey with reddish pigment on the latter and on the last abdominal segment ; ovipositor yellowish. Antennal joints 3 and 4 light yellow, with the latter greyish towards apex ; 5th to 9th grey to yellowish grey. Eyes dark, ocelli brownish. Wings, transparent with the veins and cross-veins light grey ; there is a longitudinal dark grey band along the posterior border of the fore-wing which is broadest at middle. Fringes found only on the posterior margin of the wings. All tibiae and tarsi lemon-yellow, tibial spines dark-brown.

Head as long as broad and scarcely longer than prothorax, vertex very slightly produced between the closely approximate bases of the antennæ ; cheeks parallel, eyes prominent, and less than half the length of the head, twice as broad as long, spherical and pilose. Mouth-cone rather pointed and reaching the base of mesosternum. Maxillary palpus 5-jointed. Antennæ twice as long as head ; joints 1 and 2 of same length, 3 and 4 of same length and almost of the same breadth throughout, though broader towards the apex than at the base ; joints 5 to 9 together longer than either 3rd or 4th. The latter have large sense areas. There are short hairs on all the joints and a few transparent short bristles on the 9th.

Thorax : prothorax broader than long and not armed ; pterothorax longer and broader than prothorax. Fore femora broad and stout. Wings extend to 9th abdominal segment, fore-wing of same breadth except at base and apex, cross-veins clear, costal margin with no fringes or spines ; about a dozen short conspicuous setæ present along the dark longitudinal band.

Abdomen as long as or slightly longer than head and thorax put together, posterior angles of segments 2 to 8 with a pair of short bristles and the 9th and 10th with a few longer ones.

Measurements :—Head length ·209 mm, breadth ·171 mm ; prothorax, length ·181 mm, breadth ·200 m. ; Antennal joints : I 38u, II 38u, III 86u, IV 81u, V 41u, VI 29u, VII 24u, VIII 10u, IX 5u.

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* *Memoirs of the Dept. of Agriculture, India*, Entom. ser., vol. x (7), pp. 217–316, 1928.

Described from two specimens got from grass sweepings at Coimbatore, S. India. (V. M. Coll.)

This is the first species of Erythrothrips discovered in the Old world, the two previously known ones being American, *viz.*, *E. arizonæ*, Moulton and *E. durango*, Watson ; the Indian form differs from these two in some distinct features. Some of these differences are the colour of the antennæ and legs, the extent of the dark wing band, and the structure and number of the setæ on the posterior wing-vein.

Æolothrips fulvicollis, Bagnall.

(A. M. N. H. 9, iv, 1919, p. 253.)

Bagnall's very brief description of this species may be supplemented with the following notes taken from specimens of the insect collected on Mango in Pusa Behar, and received from Mr. Fletcher :—

General colour dark to greyish or yellowish brown. Head and abdomen dark to grey brown, prothorax yellowish, pterothorax brown to dark brown and of a lighter hue than head and abdomen. Mouth-cone grey. Antennæ dark brown except apex of 2nd and basal two-thirds of 3rd which are yellowish. Legs grey to dark brown—the forelegs and the femora of the middle and hindlegs more or less suffused with yellow. Wings greyish brown with three distinct transparent cross bands, at base, middle and apex ; veins and cross veins very light grey ; fringes brownish.

Head slightly broader than long and as long as pronotum. Mouth-cone pointed reaching base of mesosternum. Antennal joints 3 and 4 of same length, joint 5 equal in length to joints 6 to 9 together. 3 and 4 have elongated and the 5th a small roundish sense area towards the apical region of each ; that of the 4th very clear over the dark brown ground colour of the joint. The long and cross-veins of fore-wing distinct, costal spines short and sharp ; 8 setæ on upper vein beyond the central cross-vein, most of them situated on the preapical fuscous area. Fringes absent on costal margin. Front legs shorter than the other four. Abdomen broadest at middle, apex bluntly pointed, 9th and 10th segments with long dark bristles.

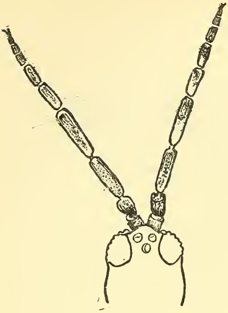
The male which was not noted before by Bagnall was also collected with the above material and the following notes on the male may be added :—

Macropterous male.—Coloured similar to female except that the apical segments of the abdomen are darker, testes reddish. 2nd and 3rd joints of antennæ except the extreme apex of 3rd almost wholly whitish yellow in some, joint 5 a little longer than joints 6 to 9 together ; the sense area of the 4th curved at apex. Wings extend to apex of abdomen. Abdomen with the 9th segment stout and broad with a strong hook like clasper and a very stout curved spine on each posterior angle ; 10th segment rather small and with a tranverse row of long bristles just before apex.

Æolothrips pandyani, n. sp.

Macropterous female.—Length 1·85 mm. General colour yellowish brown, the head and thorax, especially the latter of a deeper brown ; abdominal tergites 6 to 8 greyish brown, the rest of the abdomen yellowish brown, more yellowish than the thorax. Ventral side of abdomen and ovipositor yellow. The first four joints of the antennæ uniformly whitish yellow, 5th to 9th inclusive dark grey to black ; in some specimens the 3rd and 4th sometimes show a touch of greyish brown. Eyes black, ocelli with reddish pigment cups. Legs yellowish suffused with brown, especially so in the case of the middle and hind-legs, tarsi paler. Wings light grey brown with two distinct broad transparent cross-bands, one a little beyond the base and the other a little beyond the centre, the latter is very clear ; hind-wings with uniform very light grey infumation.

Head broader than long, cheeks gently arched and broadening towards base ; vertex very slightly projecting forwards between the bases of the antennæ. Eyes large, half as long as head. No conspicuous bristles on head ; one or two very short spines on cheek behind eyes and a few slender short ones on the occiput. Mouth-cone broad at base and broadly pointed and reaching middle of prosternum. Antennal joints 1 and 2 stout and cylindrical, 2nd longer than 1st, 3rd which is the longest of all has a distinct basal stalk and has almost the same breadth beyond the stalk, 4th shorter than 3rd, and of same shape but without the stalk. 5th to 9th together slightly longer than the 3rd, 5th is the longest of the distal five and as long as all of them together. 3rd and 4th



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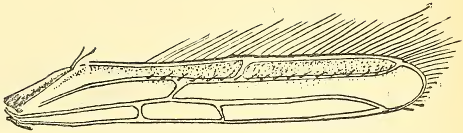

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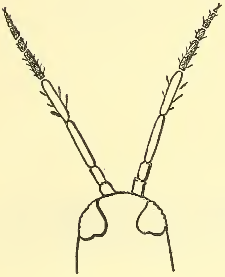

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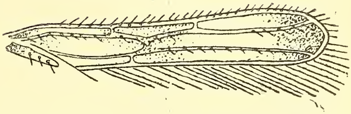

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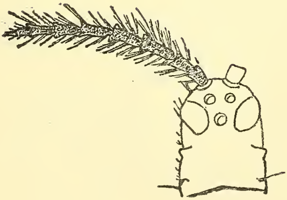

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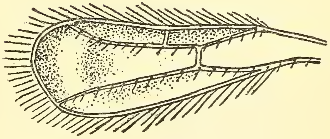

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INDIAN THYSANOPTERA

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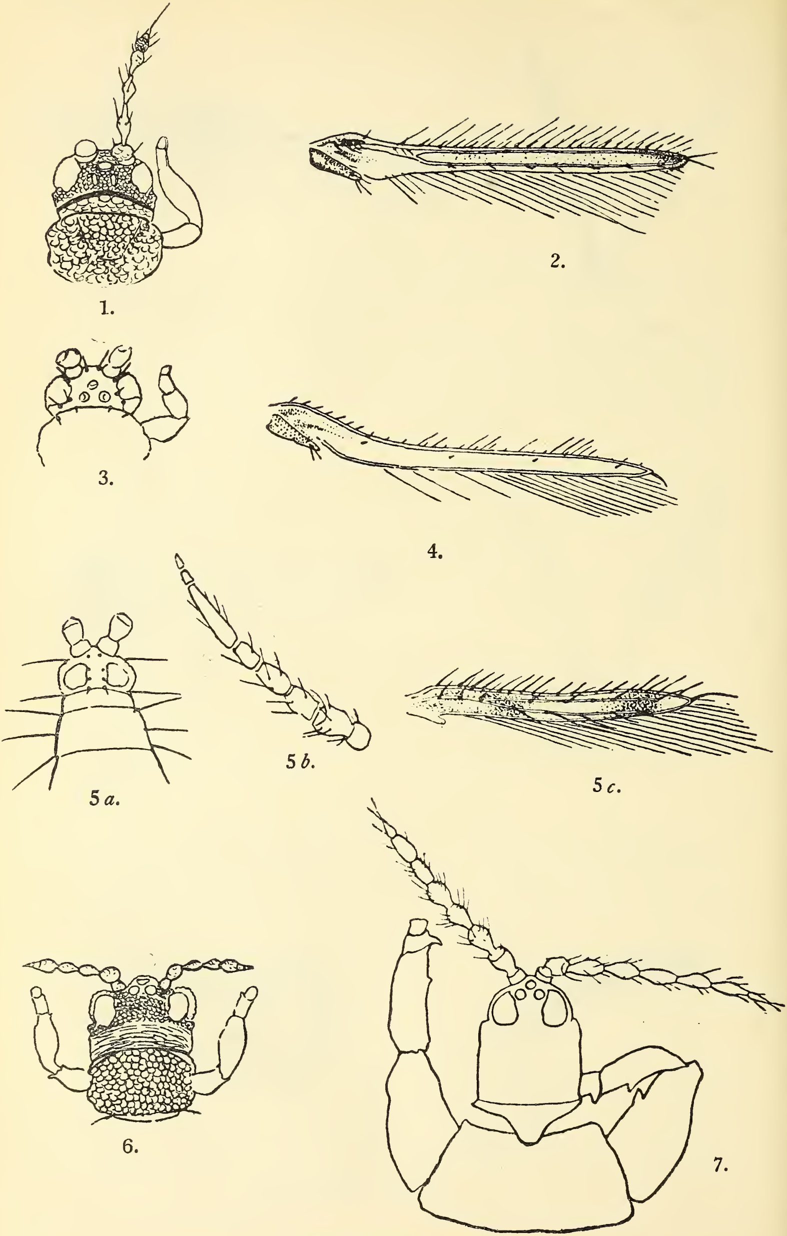
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INDIAN THYSANOPTERA

(For explanation see end of article.)

joints have a long very narrow pale membraneous area along the inner margin, which is evidently sensory.

Prothorax as long as but broader than head, sides slightly arched outwards with no conspicuous bristles. Pterothorax broader than prothorax at base but narrowing towards abdomen. Front legs rather stouter and shorter with the femora slightly incrassate; all the tibiae with strong apical spurs. Wings extend to 9th abdominal segment, fore-wings long and broadly rounded at apex with the long and cross-veins clear; the upper vein has 10 to 12 and the lower 9 or 10 short setæ beyond the central cross-vein; costal margin with about 35 small spines. Wing scale has 3 or 4 setæ in a row and 2 or 3 long bristles at apex. Wing fringes only along post half of hind margin.

Abdomen longer than head and thorax together; narrow at base, widest at middle and again narrowing towards anal segment; the latter bluntly pointed. 9th and 10th segments with moderately long bristles. Ovipositor conspicuous and turned upwards.

Measurements: Head, length ·200 mm., breadth ·222 mm.; Prothorax, length ·200 mm., breadth ·246 mm. Pterothorax, breadth ·333 mm.

Antennal joints—I 50u, II 55u, III 190u, IV 160u, V 120u, VI 50u, VII 35u, VIII 20u, IX 15u.

Macropterous male.—Length 1·555 mm. Almost of the same colour as female, but with the greyish colour more conspicuous all over the body. In the antennæ the apex of the 3rd, the 4th, and 5 to 9 joints all of a uniform greyish brown colour. Testes visible as reddish bodies.

Body elongated and slender; limbs long, abdomen long and narrow. The 5th joint of antenna much longer than all the other apical segments together. The 9th abdominal segment not so large as in *fulvicollis* and without very strongly developed spines or hooks. Measurements:—Head, length ·176 mm. breadth ·155 mm.; Prothorax, length ·155 mm. breadth ·200 mm.; Antennal joints: I 45u, II 55u, III 225u, IV 220u, V 160u, VI 25u, VII 25u, VIII 15u, IX 15u.

Described from a dozen females and a few males collected on 'Cumbu' ears (*Pennisetum typhoidum*) and grass sweepings at Koilpatti, Tinnevelly Dt. (T. V. R. Coll.)

This is the second species of '*Æolothrips*' noted from India, the first being *A. fulvicollis*, Bagnall, noted from N. India. This new form differs from *fulvicollis* in many distinctive features, such as the colour of the antennal joints and wings, the relative lengths of the antennal joints and the structure of the posterior abdominal segments in the male.

Mymarothrips garuda, n. sp.

Macropterous female.—Length 1·615 mm. This very interesting insect resembles in many respects the African species *M. ritchianus* described by Bagnall in 1926. This new form however differs from it in the following characters:—General colour is yellowish brown with reddish pigment especially over the abdominal segments 3 to 6 and the apical segment; a bright yellow median longitudinal patch extends from the ocellar region to the base of abdomen and it is broader at the pterothorax; cheeks brown, pronotum brown tinged with reddish along the sides and the median region yellow. Head longer than broad, not transverse. Prothorax broader than long. The fore-wing with a distinct transverse colourless clear patch just before the apex which is grey; it also shows a faint second cross-vein connecting the upper and lower veins just at the begining of the transverse patch, and situated in front of the one connecting the upper vein and the costa.

M. ritchiana is also shorter in length being only 1·35 mm.; the comparative lengths of the antennal joints also differ.

Described from two specimens, one collected on grape vine leaf at Coimbatore with *Rhipiphorothrips cruentatus*, H. (V. M. Coll.) and the other on turmeric leaves at Bhavani with *Panchætothrips indicus*, Bag. (P. N. Nair Coll.)

Chirothrips manicatus, Haliday. (Proc. U. S. A. Nat. Mus. xxvi, 1902, p. 134.)

Habitat: On grass sweepings, Tobacco, and a few other plants at Coimbatore.

Though this insect has a very wide distribution all over Europe and America, this is the first record of a ' Chirothrips ' from Tropical Asia.

Hydatothrips ramaswamiahi, Karny.

(Ent. Mem. Dep. Agr. Ind. ix, 1926, p. 188.)

Habitat: Besides the host plants noted before, the insect has been recently found on *Pongamia* leaves in Sholinger (V. M. Coll.) and on *Cumbu* leaves in Koilpatti (T. V. R. Coll.) This species appears to have a wide distribution in S. India.

Scirtothrips dorsalis, Hood.

(Ins. Insc. Mens. vii, 1919, p, 90.)

This insect recorded by the senior author previously as a pest of the ' Chillies ' crop in some parts of S. India, has been found to breed on a variety of plants recently in Cochin, Travancore, and the southern districts of the province.

Examination of numerous forms from different localities has shown that there are some variations in the colouring of the abdomen so much that some are likely to be taken for different species ; the writers, however, think that these different forms in colour may at the most be considered as local varieties.

Dendrothrips dwivarna, n. sp.

Macorpterous female.—Length 1·100 mm. General colour reddish brown and yellow ; head greyish brown, mouth parts lighter grey ; thorax light greyish brown profusely covered with bright red pigment all over except along margins of pterothorax which are edged with dark brown. Eyes black ; ocelli with reddish pigment. Antennal joints 1, 2 & 3 concolourous with head, the other joints whitish yellow. Front four legs greyish brown except tarsi and apex of tibiae which are pale whitish ; the third pair of legs pale yellowish white with the apex of the tibiae and its spur darkish. Fore-wings uniform greyish brown though somewhat paler at base ; hind-wings paler with a very narrow median longitudinal streak distinctly dark grey. Abdomen of a uniform pale yellowish colour, the 9th and 10th segments having a slight dark tinge at the sides.

Head small, broader than long ; vertex produced in front in the form of a broadly-pointed, short triangle, with the antennæ rising at the sides of the triangle ; cheeks strongly arched and almost completely occupied by the big eyes. The front margin of vertex has six conspicuous dark spines arranged as below—One in front of the anterior inner angle of each eye, one in front of it and one at each side of the base of the triangular projection. Ocelli distinct, posterior ones larger than the front one. The occiput has a distinct transverse collar-like ridge situated just behind the line across the posterior ocelli ; a short bristle on each cheek behind the eye. Antennæ 1st joint short and cup-shaped, 2nd stout and longer than the 1st and ovoid in shape with a few short bristles, 3rd shorter than 2nd but of the same shape almost, 4th & 5th of same length, elongate oval, broader at base and gradually narrowing towards apex, 6th longest of all, broadest at base and narrowing towards apex with an irregular transverse groove a little beyond centre making the joint appear divided into two and thus making the antennæ appear 9-jointed ; 7th and 8th together rather shorter than 6th, elongate and narrow with a few hair-like setæ, 7th of same breadth throughout. Mouth cone short, broadly pointed and reaching base of front legs ; maxillary palp 2-jointed ?

Prothorax slightly broader than head and much broader than long, sides convex with one transparent bristle on each side situated some distance in front of the post-lateral angle. Pterothorax of almost same breadth throughout and much broader than the prothorax. Mouth-cone short and bluntly pointed and extending to middle of prosternum. Wings extend to base of 9th abdominal segment ; fore-wings broadened at base and of almost same breadth beyond, the costal and the hind margins being almost parallel ; wing surface fringed with numerous very minute setæ ; at the extreme apex of the wing is a dark conspicuous slightly curved spine; upper vein not clear, but along the track there are four short setæ situated at long intervals ; one near the curve of the costal margin near base, the second at the centre, the third beyond and the fourth a little before the apex ; lower vein absent and no setæ present ; along the costal margin there are 20 to 22 spines of which 7 or 8 at the basal region are longer, the conspicuous dark spine at the extreme tip being the longest of all; wing scale with 2 or 3 conspicuous bristles at apex. Hind-wing narrow with the median longitudinal streak prominent.

Abdomen longer than head and throax together, elongate oval in shape and bluntly pointed at apex, 9th segment larger than 10th and bears a group of three or four short darkish spines towards each post-lateral angle, these two groups lying on either side of the prominent ovipositor as in a transverse line; 10th segment more or less tubular and has short weak bristles at apex.

Measurements: Head; length 110u, breadth 154u, Prothorax; length 110u, breadth 165u; Pterothorax; breadth 220u. Antenna length. 198 mm. Joints in *u*;—I 15, II 35, III 15, IV 30, V 30, VI 45, VII 20, VIII 15.

Described from five females collected on 'Jak' shoots in Kaladi, Travancore State (T. V. R. Coll) and on the same plant at Trichur, Cochin State (C. S. V. Coll.)

The insect is a distinct species and has a characteristic red and yellow colouration. In general appearance and form it resembles species of 'Dendrothrips' and it is provisionally described as a species of that genus. In the apparently 9-jointed antenna, in the structure of the wings and in the triangular projection of the vertex, it approaches 'Corynothrips' of Williams, but the bristles in this form have not the peculiar spinulose structure very characteristic of Corynothrips.

Heliothrips kadaliphila, n. sp.

Macropterous male.—Length 1·14 mm. General colour dark to yellowish or reddish brown; head, portions of thorax, the apical two abdominal segments, all the femora and tibiæ, 1st, 2nd and the 6th joints of the antennæ dark yellowish brown. All tarsi, bases of mid and hind femora, distal thirds of mid and hind tibiae, antennal joints 3, 4, 5, 7 and 8 pale whitish; joints 1 and 2 often whitish. Eyes black, ocelli with pinkish pigment. Wings uniform yellowish grey; fore-wing with a transparent colourless area a little beyond the basal dark region. Basal three-fourths of abdomen dark brown.

Head broader than long; front margin of vertex distinctly produced forwards into a short triangle between the bases of the antennæ. Eyes large, posterior ocelli bigger and placed close to each other distinctly away from the inner margin of the eyes; one slender seta at the cheek behind the eye. One small seta in front of each posterior ocellus and a few small ones in a transverse row in front of a disinct transverse collar-like ridge across the occiput. The surface of the head is closely and clearly reticulated; the cheek is arched behind the eye and more or less corrugated, the posterior lateral region is laterally drawn out and appears as a lateral projection. Antenna: Joints 1 and 2 short stout, and cup-shaped, 3rd joint longest, narrow at both ends and wide in the middle, 4th similar to 3rd and both with forked sense-cones, 5th widening towards anterior end, 6th oval almost and broadly united to the 7th, 7th and 8th long and narrow with slender bristles at apex; the antenna is twice as long as the head. Mouth-cone somewhat long and bluntly pointed, reaching base of mesosternum.

Prothorax shorter than head but broader; surface shows distinct polygonal areas, sides not armed. Pterothorax broad and oval, sides convex, broader than head or thorax. The femera and tibiae also show some reticulated surface. Wings extend to the 9th abdominal segment; costa has 20 spines, the upper vein has 2 or 3 setæ at the base and with none beyond; the lower vein shows 6 or 7 short faint ones.

Abdomen long and blunt apically; there are two pairs of short tubercular spines situated on each side of the median line, the anterior pair stouter and longer than the hind pair. The surface of the abdomen also shows the fine reticulated structure arranged in beautiful patterns in some places.

Measurements: Head length ·114 mm., breadth ·181 mm.; Prothorax length ·095 mm., breadth ·219 mm.; Pterothorax, breadth ·285 mm.; Antenna, length ·233 mm. joints in *u*: I, II, III, 76u, IV 57, V 41, VI 24, VII 14. VIII 9·5.

Macropterus female.——length 1·432 mm. Similar in colour to the male but of a deeper brown. Ovipositor long; apical margin of 9th segment with a transverse row of six long setæ extending in length to the apex of the tenth segment. In all other features like the male.

Described from a dozen males and females collected on 'Kadali' (Banana) in Coimbatore.

This insect is a typical 'Heliothrips' showing the network structure of the body surface and is quite distinct in that respect from *H. indicus*, Bag.; it also appears to be different from other species known to the writers, and from *indicus* itself in colouration and other features.

Reticulothrips peringueyi, Faure.

(S. African Jour. Nat. Hist. v, 1925, p. 145.)

This very interesting species which was first described by Prof. Faure of the Transvaal University as the type of a new heliothripine genus was collected in Coimbatore by both the writers on *Panicum* and grass sweepings. This is evidently the first record of the species for India.

Rhipiphorothrips cruentatus, Hood.

(Ins. Insc. Mens vii, 1919, p. 94.)

Recently noted as a bad pest of grape vines in the Madura Dt. and Travancore.

Selenothrips rubrocinctus, Giard.

(Franklin-Pro. U.S. Nat. Mus. xxxvii, 1908, p. 719.)

Habitat: Noted in small numbers on Cashew-nut leaves (*Anacardium*) in Trichur (T. V. R. Coll.) and in the Malabar (Y. R. R. Coll).

This insect is the notorious 'Cacao thrips' of the West Indies, and this is the first record of the species from India, though a similar insect has been recorded from Ceylon by Green—vide *Trop. Agric.* xxvii, 1906, p. 248.

This is another species the activities of which have to be watched by economic entomologists.

Ayyaria chætophora, Karny.

(Mem. Dept. Agr. Ind. En. ser. ix, 6. p. 193.)

The genus *Ayyaria* was erected by Karny from a unique female specimen found in the material submitted to him by the senior author of this paper a few years ago. Further specimens of this interesting insect were collected recently by the authors from two or three localities in the province. The following notes including a short description of the male might therefore be added to supplement Karny's description of the type:—

Female.—General colour grey to dark brown with plenty of red pigment over the thorax; head and thorax greyish brown, but the abdomen has a deeper colour except the extreme apex which is lighter and has a tinge of red pigment; the connecting membranes between the segments with a yellowish tinge; ovipositor golden yellow. The grey brown colour of the different parts of the body and on the antennal joints is of a deeper hue than in the type. The femora are distinctly dark brown except at base and apex. Karny's type was evidently a very young adult.

Mouth cone short and bluntly pointed, reaching the middle of prosternum. There is a transverse series of short setæ behind each eye, the marginal one projecting across the gena.

Macropterous male.—Length 1·21 mm. Similar in colour to the female, except that the femora and other joints of the legs are of a lighter colour, almost pale whitish; abdomen dark, with the apex lighter.

Body rather narrow and slender compared to the female. The 9th abdominal segment has two pairs of dark stout tubercular spines; these are situated along the median line, one pair behind the other towards the posterior region of the segment; the front pair ones are stout and longer than the posterior two which are very short though distinct; on the 10th segment is a pair of long up curved spines on the median region. In addition there are thinner and longer bristles at the sides of the 9th segment, the bristle on each lateral side being very long.

Habitat: On Castor shoots, Samalkot (T. V. R. Coll.); on garden Croton, Coimbatore (V. M. Coll.); on Grass sweepings, Walayar forests, Malabar (T. V. R.).

Fulmekiola indica n. sp.

Macropterous female.—Length 1·210 mm. General colour uniform pale to lemon yellow; in some specimens the thorax has a deeper tinge and the abdomen a very light hue ; the mouth-cone margins of thorax narrowly, the apex of abdomen including tip of ovipositor tinged with grey. Wings transparent with very light greyish infumation ; on the light yellowish ground colour of the head can be made out three light colourless streaks, one along the median line from therefore margin and the other two one from behind each eye, all the three converging behind at the base of the mouth-cone. Eyes black, ocelli with red pigment. Antennal joints 1 and 2 concolourous with head ; 3, 4, and 5 pale whitish with a slight tinge of yellow ; basal half of 6th yellowish grey, its distal half and the 7th grey ; the 5th is slightly grey towards apex ; 3rd to 7th margins very narrowly dark. Legs similar in colour to body.

Body rather elongated ; head distinctly longer than broad ; vertex before the eyes projecting conically at the anterior margin ; cheeks very slightly arched ; the occiput with light irregularly arranged transverse striæ near base. Eyes large, facetted, oval, one-third the length of head. Just behind the anterior margin of the head and posterior to the bases of the antennæ is a transverse row of long bristles, about 5 or 6 in number, of these the ones on each side of the median line are very conspicuous. Behind a line across the hind margin of the eyes and the posterior ocelli is another irregular transverse row of smaller bristles ; the lateral one on each end of this row projects across the gena. Mouth-cone rather long and attennuated reaching anterior margin of mesosternum.

Prothorax shorter than head, broader than long, margins gently arched. Antennal joints : 1st short and stout, broader than long, 2nd longer than 1st and broadly oval, almost globular, with a short conspicuous seta on the surface ; joints 3, 4, 5 of almost same length and shape, all are slightly constricted at base, broadly oval beyond that and broadly attached to the next at apex ; 6th elongate oval and the longest of all; 7th of almost same breadth throughout, blunt at apex and with a few setæ.

Prothorax shorter than head, but broader than long, margins gently arched ; at each antero-lateral angle is a small anteriorly directed spine and at each posterior angle a pair of long but weak bristles ; there are also a few smaller ones along the basal line. Pterothorax broader than head or thorax, longer than broad, sides strongly arched at base but almost parallel beyond wings and narrow extending to 8th abdominal segment ; along the costa are 22 to 24 setæ, the ones towards the apex being longer ; on the upper vein at the basal part there are 6 or 7 setæ at equal intervals ; beyond that are 4 situated at long intervals ; the lower vein has 12 setæ arranged at regular intervals ; the 7th in the upper vein is situated opposite to the 3rd of lower vein, the 8th opposite to the 7th of lower, 9th opposite to the 11th of lower, and the 10th beyond 12th of lower, near apex. Front legs stouter than the other legs.

Abdomen elongate oval, longer than head and thorax together, abruptly narrowing at the 8th segment. On the 9th segment is a transverse row of 4 or 5 very long bristles extending beyond the anal segment in length ; on each side of the median line of the 10th segment is situated an equally long bristle ; spines at apex of abdomen shorter.

Measurements : Head length, ·154 mm. breadth, ·121mm.; Prothorax, length, ·110mm., breadth ·154mm. ; Pterothorax, breadth. ·209mm. ; Abdomen length, ·616mm., Antenna length, ·242mm. ; length of joints in *u* ; I 20, II 35, III 45, IV 45, V 50, VI 55, VII 20.
mm.

Macropterous male.—Length ·880 mm. Somewhat smaller than the female in size but in colour and general structure similar ; the testes are seen through the skin as bright red bodies.

Described from a dozen females and one male collected on sugarcane leaves at Samalkot, Godavari Dt. (V. T. Rao Coll.).

The genus '*Fulmekiola*' was erected by Karney in 1925 (Bull. Deli. Prof. Thys. on Tobacco, No. 23) for a form close to 'Thrips' but differing from that genus in the slender and elongated body, the long head and mouth-cone, and the weak prothoraric bristles.

Scolothrips asura, n. sp.

Macropterous female.—Length. ·902mm. General colour a mixture of pale yellow and dark brown ; head, antennal joints 1 & 2, pterothorax with base of abdomen, and abdominal segments 6 to 8 dark grey with profuse red pigment, prothorax, the other antennal joints, the middle abdominal segments and apex of abdomen yellowish to pale white; the ovipositor yellow and the legs pale whitish; wings with fuscus infumation upto the middle, with a small hyaline patch on it just beyond the base, the middle region broadly transparent, then again with fuscous cloud almost to the apex which is however transparent.

In most other respects this new form is similar to the well-known *S. sexmaculatus*, Perg. The important features in which this differs from known species are: The peculiar colouration of the body and the wings, the strong spines of the wing and the weak ones at the anal region and the difference in the relative measurements of the antennal joints 2 & 6 compared to that in the other species, the 6th being more than twice the length of the 2nd.

Described from two female specimens collected on 'Banana' leaves, Coimbatore (V. M. Coll.).

Anaphothrips flavicinctus, Karny.

The senior author has collected a brachypterous female of what is undoubtedly Karny's *A. flavicinctus*, which is the same as Bagnall's ***Euthrips citricinctus***.

Length 1·188 mm. General colour and form as in the macropterous form; the following striking features may be noted.—Antennal joints pale whitish with a tinge of light yellow, apex of 4th light grey, 5th to 8th dark grey with the base of 5th lighter. Legs uniform whitish yellow. Wings very much reduced, shorter than head in length and transparent, with a few very short setæ at the margin.

The fringe on the posterior margin of 8th segment and the bristles on apical segments well developed.

One female collected on 'Cumbu' ears in Koilpatti, Tinnevelly District (T. V. R. Coll.)

Oxythrips hemavarna,[1] n. sp.

Macrpterous female.—Length 1·102 mm. General colour uniform golden yellow; mouth-cone and tip of abdomen slightly darkish, ocelli with orange pigment; antennal joints yellow with the 4th and 5th lightly shaded with brown, the 6th of a deeper brown and the 7th and 8th of a lighter hue.

Head slightly broader than long, vertex and cheeks arched; eyes roundish, ocelli placed close to one another, the posterior ones being very close to the inner margin of eye. Mouth-cone bluntly pointed extending slightly beyond middle of prosternum.

Prothorax distinctly longer and broader than the head and as long as broad, sides arched gradually broadening towards the posterior margin; postero-lateral angle on each side with a pair of short faint transparent bristles. Pterothorax broader than prothorax, mesothorax broader than metathorax. Fore femora thick; hind tibiae slender and longer than the middle ones. Wings: basal portion of upper vein with 5 or 6 short setæ, and the distal half with 3 or 4 placed at long intervals; these are more conspicuous than the others. The lower vein has only 3 or 4 at long intervals; fringes long and greyish. There is a clear narrow streak along the lower vein. Costa of upper vein with 20 to 21 spines.

Abomen elongate, gradually broadening from the 1st to the 6th segment and then narrowing and ending almost in a point; 9th and 10th segments form a cone; 10th segment slightly longer than the 9th.

Measurements: Head, length ·105 mm., breadth ·114 mm.; Prothorax, length ·152 mm., and same breadth; Pterothorax breadth ·209 mm.; Antenna, length ·228 mm.; joints in μ: I 24, II 24, III 33, IV 38, V 27, VI 38, VII 10, VIII 10:

Described from two females on Mango leaves: Coimbatore. (V. M. Coll.)

This insect was submitted to Dr. Priesner for confirmation of the identification.

Tryphactothrips rutherfordi, Bagnall.

(A. M. N. H. 8, xv, 1915, p. 319.)

This insect has been found very common in and around Coimbatore. The following notes are added to supplement Bagnall's description of the type.

The antennæ are short and stout; joints 1 to 5 yellow, the 2nd a little deeper,

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[1] Gold-colored.

6th to 8th grey; joint 1 slightly longer than broad and cylindrical, 2nd almost globular, broadest of the joints; 3rd narrow at base, widest at middle and again narrowing towards apex and longest of all; 4th narrow at base but gradually widening towards apex and slightly symmetrical; 5th to 8th closely connected together, 5th slightly constricted at base and broadly and closely connected with 6th. the connections between the style and the 6th not well defined.

The chætotaxy of the wings shows a difference between that of Bagnall's type and the specimens collected by the authors in South India. The arrangement in the forewing is this: - Costa 10 or 11 short and stout ones; besides these the apex of the costa at the tip of the wing has two conspicuous curved spines being the longest in the body; upper vein 3 near base of which one is light coloured and the other two black, 3 lighter ones at the middle region, 3 black ones again, and 1 lighter one towards apex; thus there are 10 in the upper. The lower vein has 9 in all arranged more or less as in the upper vein and of similar colour and size; it has only 2 near the base instead of 3 as in the upper. In the type costa has 8 or 9, upper vein 7, and the lower 8. It remains to be seen whether these differences are only varietal or specific.

Panchaetothrips indicus, Bagnall.

(Rec. Ind. Mus. vii, 1912, p. 257.)

This insect, which has been noted only on Arrowroot and Turmeric till now, was recently collected on *Hæmelia patens* in Coimbatore. (V. M. Coll.).

Euryaplothrips, n. gen.

This new genus is erected to include an interesting haplothripine form near Bagnall's *Priesneria* and *Trybomiella.*

The insect is quite different fom either *Priesneiria* or *Trybomiell* in having the head very short and distinctly broader than long, and in this respect it very closely approaches the genera *Brachythrips* and *Austrothrips*. The forewings have no duplicate hairs as in *Trybomiella* but have the general structure of a haplothripine wing. On the whole the most striking feature is the thick, short, broadheaded form; at the suggestion of Dr. Priesner, the type is named *E. crassus.*

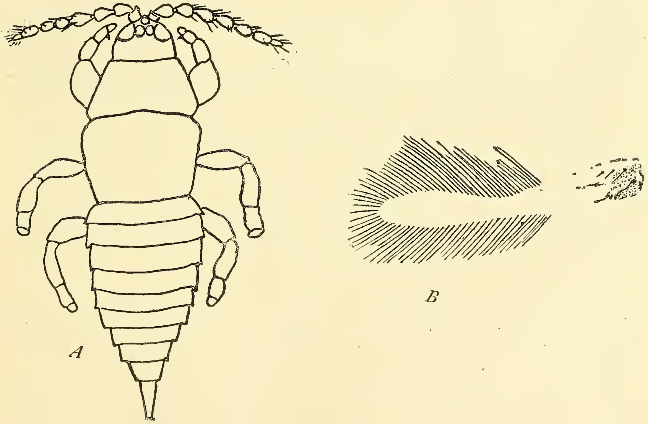

FIG. 1. *Euryaplothrips crassus*, n. gen. & sp.—*A*. Outline of insect. *B*. fore-wing.

Euryaplothrips crassus n. sp.

Macropterous female.—Length 1·30 to 1·60 mm. General colour uniform light to dark brown; the front tibiae and all the tarsi pale yellowish to yellowish white; antennal joints 1 and base of 2 concolourous with head, 3 to 6 pale greyish, 7 and 8 of a deeper grey. Portions of pterothorax and apex of tube of a lighter tinge. In some specimens the thorax is found suffused with reddish pigment. Wings transparent, fringes brownish; the extreme base of fore-wing tinged with grey brown.

The general form of the body short and stout built. Head distinctly broader than long, shorter than prothorax; the front margin slightly arched, the cheeks almost parallel behind the eyes, no conspicuous bristles on the head or cheeks, only a few very small setæ on the occiput and near the eyes; the occiput with faint transverse striæ near the base. Mouth-cone as long as head, bluntly pointed and reaching a little beyond middle of prosternum. Eyes large, ocelli also large, the posterior ones being bigger than the front one; the eyes and ocelli are far in front almost near the front margin. Antennæ considerably longer than head; 1st joint short and cup-shaped, slightly longer than broad, 2nd more or less funnel shaped being constricted at base and widening towards apex; at the apex on each side of the junction with the 3rd joint is slightly crenulated; 3rd to 5th more or less of the same length and shape, narrow at base and broadening towards the next joint; the apical region of joints 3, 4 and 5 of a transparent colour probably sensory (?) 6th almost of the same breadth throughout; 3rd to 5th well supplied with sense-cones. Prothorax posterior margin much broader than the anterior margin, longer than the head; there is a conspicuous transparent bristle at each margin just behind the antero-lateral angle; there is in addition a bristle at the middle of each margin; the postero-lateral angles rounded and with a pair of clubbed bristles of which only one is conspicuous. Pterothorax stout and broad. Front legs stout with the femora more or less incrassated and the tarsus with a small conical tooth. Wings fairly long and extend to the 9th abdominal segment; haplothripine in structure, constricted at the middle and widening at apex; fore-wings have no duplicate hairs, and the basal bristles are medium sized and clubbed.

Abdomen longer than head and thorax together, broader than pterothorax at base, two pairs of wing retaining bristles on each segment clear, the second pair being stouter and longer.

Measurements: Head, length 1·320 mm., breadth ·176 mm., Prothorax, length ·176 mm., breadth ·390 mm.; Pterothorax, breadth ·396 mm; Tube, length ·110 mm., Antenna, length ·330 mm, joints in *u*—I 40, II 50, III 55, IV 60, V 55, VI 45, VII 43, VIII 30.

The male is similar to the female in general form and structure; the bristles at the posterior lateral margins of the 9th abdominal segment are more conspicuous.

Described from about a dozen specimens collected on *Amaranthus* flower heads in Coimbatore (T. V. R. Coll.)

Examination of more material of these haplothripine forms in India and a detailed study of the peculiarities of these genera would help us in judging correctly the real affinities of the genera like 'Haplothrips, Zygothrips', Priesneria, Trybomiella and other allied forms.

Haplothrips (Trybomiella) ramakrishnai, Ky.

(Mem. Dep. Agr. Ind. Ent. Ser. ix, vi, p. 218).

According to Bagnall this species falls under the sub-genus 'Trybomiella' being characterized by the absence of duplicate cilia at the apex of the fore-wing.

Haplothrips (Trybomiella) tirumalraoi, n. sp.

Macropterous male.—Length 1·760 mm. General colour uniform brown; this is deeper on the head, thorax, legs and the last three abdominal segments; abdominal segments 2 to 8 of a pale greyish brown colour. Antennal joints 1 and 2 same colour as head, 3 to 5 light yellowish brown, 6 to 8 dark greyish brown. Tarsi of all legs lighter. Wings clear, fringes greyish. Ocelli with slight reddish pigment; tip of mouthcone dark.

Head elongate, longer than prothorax and broadest behind eyes; cheeks almost parallel though imperceptibly narrowing towards base where the breadth is slightly less. Eyes longer than broad, situated rather forwards almost near the front margin ; ocelli close to inner margin of each eye. There is a distinct postocular bristle projecting across the cheek, blunt at tip. Mouth-cone broadly rounded and extending to middle of prosternum. Antenna: 1st joint short and cup-shaped, 2nd narrow at base and broadly oval towards middle ; the apex at the connection with the 3rd joint is more or less crenated on each side of the junction ; there is a single conspicuous sense-cone at the inner apical angle : 3rd joint distinctly constricted at base and gradually widening towards apex just before which it is broadest; 4th almost as long as 3rd and of same shape-joints 3 to 6 almost of same length and shape ; 7th joint has the sides almost parallel and is broadly connected with the 8th ; 8th joint is a long cone. Prothorax rhomboidal and short, the posterior margin much broader than the anterior ; the antero-lateral angles have each a knobbed bristle almost as long as the head. The posterior angles rounded and each with a knobbed bristle. Pterothorax longer than prothorax but not much broader ; sides almost parallel. Front legs rather stouter than the hinder four. Wings narrow and much broadened at apex, no duplicate hairs at apex of forewing. Three knobbed bristles at base of fore-wing of almost equal length. Abdomen elongate, sides almost parallel up to 8th segment, thence narrowing towards tube. The segments have the usual bristles at the postero-lateral angles ; those of the 9th as long as the tube, the setæ at apex of latter slightly longer than the tube and pointed.

Measurements of holotype : Head length ·220 mm., breadth ·176 mm. ; Prothorax length ·132 mm., breadth ·275 mm. ; Pterothorax breadth ·286 mm. ; tube length ·132 mm. ; Antennal joints in *u* : I 30, II 50, III 60, IV 60, V 55, VI, 57, VII 50, VIII 35

Described from one unique specimen collected by V. Tirumal Rao on *Colocasia* in the Northern Circars ; the species is named after the collector.

The species is quite different from *H. ramakrishnai* in many respects.

Euoplothrips malabarica, n. sp.

Macropterous female.—Length 1·65 mm. General colour light greyish brown, base of mouth-cone, apex of fore-femora, the fore-tibiæ, the bases and apices of the four hind-tibiæ and all tarsi pale yellowish ; the fore-tibia has the side; narrowly margined with dark grey. Antennal joints with the exception of the extreme base of the 3rd and 4th joints brown ; the latter pale whitish. The connecting membranes between abdominal segments of a paler colour. Ocelli with reddish pigment. Wings with very light grey infumation ; the extreme base with greyish tinge ; the hind-wing with a central narrow light greyish streak. Tube of a darker tinge than abdomen or thorax.

Head as broad as long, longer than prothorax. Vertex arched ; cheeks behind eyes almost parallel imperceptibly broadening towards base where it is broadest, the cheeks are also slightly serrated with a few very small setæ. Eyes oval, wide apart from each other and placed far forwards on the vertex ; the post-ocular bristle is conspicuous and almost as long as the eye and knobbed at tip. The surface of the occiput with irregular transverse striæ. Mouth-cone rather short, bluntly pointed and not reaching the middle of the posternum. Antenna more than one-and-a-half times as long as the head.

Prothorax shorter than head ; a short knobbed bristle at each antero-lateral angle. Pterothorax broader than abdomen, narrowing towards base of the latter. Wings not perceptibly constricted at middle and broader at base than at apex. Fore-wings with 5 or 6 duplicate cilia at apex and the 3 basal bristles knobbed and as long as the prothoracic bristles. Four legs distinctly stouter ; femora incrassate with a conspicuous tooth at middle of inner surface and another small but distinct denticle a little beyond it ; fore tibia at middle of inner margin with a distinct projection bearing a bristle and a few smaller bristles along the inner margin on each side of the projection ; the fore-tarsus with a long tooth at inner margin near base. Abdomen longer than head and thorax ; tube shorter than head and its apical setæ pointed and longer than the tube. The bristles at the postero-lateral angles of the segments more or less bluntly pointed ; the wing retaining bristles conspicuous and sigmoid.

Measurements of holotype female : Head length or breadth ·176 mm. ; prothorax, length ·132 mm., breadth ·242 mm. ; pterothorax, breadth ·330 mm. ; tube length ·099 mm. ; Antenna, length ·308 mm. ; length of joints in *u* : I 35, II 45, III 55, IV 55, V 48, VI 43, VII 38, VIII 28.

Male of a lighter colour and of a weaker build ; length 1·320 mm. ; in other respects similar to female though the armature of the fore-legs is slightly weaker.

Described from half a dozen females and two males collected by the senior author on spikes of 'Pepper' (*Piper nigrum*) in Taliparamba, N. Malabar. Was found in company with *Haplothrips pictipes*, Bag. Except for the distinct armature of the fore-legs which places this insect in the genus 'Euoplothrips', it resembles *H. pictipes* in many respects. It is quite different from Hood's type of the genus *E. bagnalli* recorded from Australia in 1916.

Gynaikothrips kannani, Moulton.

(Bombay N. H. Soc. Jour. xxxiii, 1929.)

Habitat : On leaf galls of *Ficus retusa* in Maddur, Mysore (1924).

This species was recently described by Moulton from material submitted by Dr. Kannan of the Mysore Agricultural Department as collected on *Eugenia* in Bangalore. The senior author had collected a solitary specimen of this insect in 1924 and, for want of further material, kept it with his unworked lot ; on comparison with the description of *kannani* recently, it was found to agree with the latter. The species appears to be very close to *G. moultoni* described by the senior author in his Memoir.

The genus *Gynaikothrips* is one of the commonest of the gall thrips in the tropics and many species have been described. Those so far known from India may be separated with the help of the following rough key :—

I. FORETARSUS UNARMED
  A. Hind and mid tibiæ wholly yellow :
    i. Wings with infumation ; 7 to 10 duplicate hairs to fore-wing ... ... *G. pallipes*, Ky.
    ii. Wings clear ; 14 to 15 duplicate hairs... *G. interlocatus*, Ky.
  B. Hind and mid tibiæ partly dark brown and partly yellowish :
    i. Post-ocular spine long and well developed ... ... *G. chavicæ*, Zim
    ii. Post-ocular spine small—
      a. Front tibia bright yellow, mid and hind tibiæ dark brown except at extreme apex ... *G. moultoni*, Ram.
      b. Front tibia yellowish brown at base, mid and hind tibiæ light brown at basal two-thirds and the rest yellowish ... ... *G. kannani*, Moul.
II. FORETARSUS WITH A TOOTH
  A. Head and tube comparatively longer, colour deep brown ... ... *G. uzeli*, Zim.
  B. Head and the tube shorter, colour pale greyish brown ... ... *G. malabarica*, Ram.

EXPLANATION OF PLATES.

PLATE I.

1. *Erythrothrips asiaticus*, n. sp.—Head and antennæ.
2. *Do.* do. Right fore-wing.
3. *Æolothrips pandyani* do. Head to show antennæ.
4. *Do.* do. Fore-wing.
5. *Mymarothrips garuda* do. Head with antennæ.
6. *Do.* do. Fore-wing.

PLATE II.

1. *Heliothrips kadaliphila*, n. sp.—Anterior region of body.
2. *Do.* do. Right fore-wing.
3. *Dondrothrips dwivarna*, do. Head to show setæ.
4. *Do.* do. Right fore-wing.
5. *Scolothrips asura*, n. sp. (*a*) Head and Prothorax. (*b*) Antennæ (*c*) Fore-wing.
6. *Tryphactothrips rutherfordi*, B.—Fore part of body.
7. *Euoplothrips malabarica*, n. sp.—Fore part of body.

THE NATURAL HISTORY OF *CALOTES VERSICOLOR* (*BOULENGER*), THE COMMON BLOOD-SUCKER.

BY

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The writer is primarily interested in the study of the formation and development to maturity of the reproductive or germ cells in animals and in the study of the problem as to whether these germ cells segregate or separate themselves off very early from other somatic or body cells in the embryonic history of animals. As Weismann thought, this is a problem which has a significant bearing on the Theory of Heredity.

With that object in view, during the last five years, his efforts have been mainly directed to studying the breeding habits, the egg-laying period, and in obtaining accurately timed and closely graded embryonic series in the developmental stages of this lizard, which is fairly common in the environs of Ahmedabad. The following observations may perhaps interest the readers of our *Journal* and we hope that these will be supplemented in the course of time by the students of Natural History in this or other part of the country.

Keläart (1852), Gunther (1864), Murray (1884), and Boulenger refer to this common Indian Lizard in their works, which are mainly concerned with the identification and clâssification of animals. They give none or few details regarding the habits of this lizard. So far as the writer is aware, a more or less detailed account of the breeding habits, the egg-laying period, the period of the incubation of the eggs and the attainment of sexual maturity by the developing young and the seasonal variations in the testes and ovaries has not yet been published in this country.

For determining the generic and specific characters, colouration, etc., the interested student may refer to the works of the writers, above mentioned. However, we may mention in passing that these lizards are quite harmless creatures, not difficult to capture. As regards size, though Boulenger records the average adult size around four and a half inches from snout to vent, some of our adult males measure upwards of six inches from snout to vent. Again in the first year of their life history as the young attain sexual maturity, particularly after about four to five months' growth, the disparity in body size between the sexes comes into existence and is most marked in their first breeding season, the female being decidedly smaller and slenderer in build than the male.

Though colouration is variable there are definite tracts or patterns which always appear at the same place in the process of colour change. Again, contrary to what Gunther says regarding the difference in colouration of the throat and the snout of sexually mature and immature specimens in his work, we have observed that the characteristic colouration of the immature specimens both male and female, the dark brown narrow transverse bands across the orbital region, particularly those dark brown streaks on the lower jaw, which radiate from the ventrum of the snout to the throat are well preserved and persist even after sexual maturity is attained.

Calotes versicolor is found in cultivated and uncultivated fields, on trees, shrubs, on Euphorbia hedges and in the gardens, occurring normally throughout the year. However, these lizards are not so commonly met with from about the middle of November till the end of February. It is likely that in regions which are more sandy and dry as Ahmedabad, and which are more cold in the dry season in India, these lizards, if they do not actually hibernate, undergo a periodic inactivity, a cold weather torpor, moving little in search of food. The following observations made by Mr. McCann of the Bombay Natural History Society in a neighbouring tract, Rajputana, may perhaps lend support to this view : '*Calotes versicolor* is very common in Rajputana during the hot and rainy weather, but it is conspicuously absent in the winter. I have found these lizards during the winter months sheltering in disused chimneys, behind cloth curtains, and even in dirty clothes baskets. When disturbed they are comparatively slow in their movements and will soon return to their place of shelter in spite of being disturbed several times. On one occasion I found two in a nest composed of tow which may have been made by squirrels, for I do not believe that these lizards are capable of constructing a nest of their own. In late February *Calotes* is once more about.'

Food

Many observations have not been made by us on its food habits amidst natural conditions, but an examination of the contents of the stomach of the dissected specimens frequently revealed hard or undigested parts of beetles, large and small ants, insect larvæ and wings of butterflies. While in confinement, under laboratory conditions, grown up specimens could be kept going for considerable time on such food as bits of fresh frog-liver and fat-bodies with an occasional grasshopper or butterfly. The former kind of food was often forced into their mouths. But the greatest difficulty was encountered in the direction of finding suitable food for rearing the young which hatched from the eggs. These were kept in as natural a condition as possible in the open, in a wire-netting box sunk into the earth so that natural earth may form from its bottom. Feeding them on white ants and small quantities of fresh frog-liver and fat-bodies they were kept going for about a month; only three or four specimens survived a period of a month and a half. Once they grow to be about four or five months old they would stand confinement better, and be easier to keep on such kind of food as mentioned above. Some specimens captured from the wild, which we know to be three to four months old, and which were reared in the laboratory on this food subsequent to their capture, lived for a considerable time—for about six to seven months after the date of their capture. They did not die; they were in a healthy condition throughout and were ultimately set free.

The Breeding Season

From the observations recorded below we may reasonably infer that the reproductive activities and the egg-laying period of *Calotes versicolor* fall within a definite, well-marked part of the year. It does not start earlier than about the first or second week of May, and it ends about the first or second week of September. Observations on the periodic variations in the growth, size and appearance of the organs of reproduction, both testes and ovaries, and the microscopical examination of these organs, enabling one to determine at which stage ripe and mature germ cells appear in them are perhaps the best criteria to determine the onset and the end of the breeding season.

Seasonal Variation in the Gonads

During the middle of the breeding season, from June to August, the testes are deep pink in colour and the shape of a regularly formed seed of ground-nut, about 17 mm. long and 9 mm. wide. From about the third or fourth week of September they begin to decrease in size. The decrease is invariable and constant. By the last of October the testes are reduced to half the maximum size, about 8 mm. long and 4 mm. in cross section. In December and January they look remarkably small as compared with their size at the height of the breeding season. By the last of January they measure not more than 2·5 mm. long and about 0·5 in thickness. This decline is most remarkable and striking. But they start increasing in size in February. During the whole of February and first two weeks of March the increase is slow. In April there is considerable activity and they seem to progress rapidly. But the most remarkable increase takes place between the third week of April and the first half of May. They reach their maximum size by the last of June. The microscopical examination of the sections of the testes reveals the fact that this externally visible remarkable increase in the growth and the activity of the gonad, particularly during the third and fourth week of April and the first two weeks of May, is consequent upon an internal activity. We find that from this stage onwards an enormous number of ripe, matured spermatozoa are being produced internally in the tubules of the testes, heralding the onset of the breeding season.

The ovaries showed the same seasonal variation in size and form, with this difference that they are so much reduced in December and January that they could scarcely be identified as being present at all. Again the ovary, as it begins to grow on the approach of the breeding season, seems to grow more steadily and to increase without that sudden spurt so characteristic of the testes. In March the eggs in the growing ovaries look like small white pearls. Yolk deposition in the eggs begins in April. At this time they look yellow in colour. By the last week of May a fully-matured egg measures in the ovary from 10 to 12 mm. in length and from 5 to 7 mm. in thickness, and some eggs have the characteristic oblong shape even in the ovary.

The Egg-laying Period :—In our locality, the majority of females lay eggs during June, July and August, though the farthest limits for the egg-laying period one would like to put on the strength of all the observations one has made would be from about the third week of May to the second week of September. That these are probably the farthest limits is borne out by the fact above stated, that the organs of reproduction, both male and female, are not ready for functioning earlier than May and their activity declines in the third or fourth week of September.

However, the earliest specimen of a gravid female secured from the field was on June 25; though, this does not preclude the possibility of obtaining from the field such gravid females earlier in the breeding season if they are intensively searched for. In this female, when her abdomen was opened on the day she was secured, there were six, fully developed, large, shelled-eggs in a row, antero-posteriorly, in each oviduct on either side of the body. These she would have laid in ordinary course within a week at the outset.

Moreover, the above-stated observation, that the most of the egg-laying is done in June, July and August of the breeding season is also supported by our experience of collecting naturally laid clutches of eggs in the field. In the course of three or four breeding seasons the majority of the egg-nests were collected within a period lying between the second week of July and the last week of August.

The Incubation Period for the eggs :—From the observations and experiments detailed below one may reasonably infer, that in nature the young of *Calotes* hatch out of the eggs on the completion of a period of incubation lasting over six or six weeks and a half after the eggs have been deposited in earth by the mother.

In nature the eggs are laid in moist earth in a hole six to seven inches deep and may contain from eleven to twenty-three eggs. Kelaart observed five as the minimum. While eight is the maximum according to Kelaart; Gunther records sixteen. Another observation also of these authors we are unable to corroborate. These authors record that the eggs of this lizard have been found also from the hollows in trees. In over four years of collecting we have not once obtained eggs from such places. The eggs are not glued together and lie separately in the nest.

That in the course of a breeding season one female would lay more than one batch of eggs is probable. It is also probable that normally more than twelve eggs do not go to form a clutch laid at one time, though in two or three gravid lizards we operated upon in the breeding season, there were in each oviduct on either side of the body ten to eleven eggs in a row antero-posteriorly. All of these were large, fully-developed eggs ready to be laid, looking about the same as freshly laid eggs.

The shell of a newly laid egg is pure white, soft and leathery. The egg is ovoid in shape about 10 to 11 mm. long and from 4 to 5 mm. broad. The size increases as the embryo grows inside, the most rapid increase in the size of the egg taking place from the fourth to the eighteenth day of incubation. Then it does not increase appreciably. But about three days before hatching, it shows a slight additional increase in length and breadth.

Gravid females were watched and in several cases the eggs were collected soon after they were deposited. In other cases, where the females were not actually seen, though the collected clutches of eggs looked similar to those freshly laid, we had little difficulty in finding out before how long the eggs had been deposited. One or two eggs from such a clutch would be opened and the state of the embryo inside compared with that inside a freshly laid egg previously known. In the course of three or four breeding seasons a fairly large number of such clutches of eggs collected from the field were brought to the laboratory, always covered in moist earth, never exposed, and incubated in a manner we shall presently describe.

Another expedient was also adopted. Gravid females were caught alive and brought to the laboratory. They were not chloroformed; their abdomens were cut open. Having exposed the oviducts, ripe, shelled eggs were quickly detached from the walls of the oviduct and as quickly embedded in moist, sandy earth kept ready in small boxes.

These eggs as well as the eggs naturally laid and collected from outside, all carefully timed and labelled, were left embedded in ordinary soil. Moist rather sandy earth was used, three to six inches deep in ordinary wooden boxes. These boxes were left on the window sills of the laboratory room exposed throughout to diffused sun light entering the room through large, glass-pane windows. Every twenty-four hours, in the early stages, enough water was sprinkled on the earth containing the eggs to keep it moist. At regular intervals, 12, 24, 48, 72 hours, one or two eggs were opened and the required stages of the embryos fixed. On all cases, without a single exception, embryos were perfectly fresh and active with pulsating heart and deep red, healthy blood. In the course of three or four breeding seasons not once have we seen an egg giving an embryo anyway decompsed or disorganized, unhealthy or shrunken. Nor have we seen any difference in the development and subsequent behaviour between the eggs naturally laid and collected from the wild and those derived from the oviducts of the females operated upon in the laboratory. Many series of eggs were left undisturbed to hatch out; and in all cases at the expected time on the completion of the incubation period there emerged plump, healthy-looking young from all those eggs incubated in the laboratory in the manner described above. The majority of the eggs that have been thus treated in our laboratory hatched after a period not less than 42 nor more than 45 days.

A day or two before hatching, at one end of the egg there appears a small dark patch on the now dirty-white shell, 3 mm. in diameter. At the time of hatching this spot tears in the middle with three or four radiating slits which, however, do not extend much beyond this slightly darkened area. First emerges the snout then the head. In about half an hour from the appearance of the tear, the young is free from the shell.

The period of attaining Sexual Maturity after hatching :—By prolonged observations and carefully controlled experiments we have determined that amidst natural conditions the young of *Calotes* become sexually mature nine to twelve months after they emerge from the eggs. In other words, the young that are hatched at the close of a particular breeding season become parents and lay eggs in the succeeding breeding season.

Taking the smallness of size as a reliable criterion of sexual immaturity we began collecting from the field at the close of a breeding season the smallest-sized individuals every fortnight or at shorter intervals. Of course, it was assumed that the smallest-sized individuals were the products of the eggs hatched in that breeding season. Thus a series of all small-sized individuals from October to May was obtained. The organs of reproduction of these small-sized individuals were examined as these were collected from time to time, and these organs were compared with those of large, undoubtedly matured individuals more than one year old. From October to about the end of February little or no difference was noted in the size, growth and activity of the gonads of both kinds of individuals large, undoubted adults, and the small-sized individuals regarded as sexually immature. But on the approach of the breeding season, March, April and May, there was the same characteristic sudden growth and activity in the gonads of the smallest-sized individuals as in those of the larger ones. Though the external body size of the two groups of individuals differed, there was little difference in the growing dimensions of their ovaries and testes.

In order to test the validity of this hypothesis and confirm the observations already made, the following expedient was adopted. A large number of freshly laid eggs, including one or two series derived from the oviducts of the operated, gravid females, was incubated in the laboratory as before. Fifty to sixty young *Calotes* thus hatched in the laboratory were set free in the college compound and in a neighbouring field. This plan was devised with a view to finding out whether the specimens thus set free, would grow amidst natural conditions, attain sexual maturity and could be recovered as sexually matured individuals in the succeeding breeding season. In order to mark these young ones, so that the same specimens may subsequently be recognized when captured from the field on the approach of and during the succeeding breeding season we amputated their toes. Some young had the innermost toes of both their anterior limbs cut off with proper antiseptic precautions. Other specimens were deprived of their outermost toes of each of the hind-limbs. In other individuals other toes were cut off. In this way the young specimens, which had hatched in our laboratory a few hours before, were variously marked; their records were kept in a note book and they were set free during August and September last year.

The experiment has been successful. Though an intensive search has not been made to recover all or most of these marked specimens left off last August and September, so far we have recovered five of these. All have grown to a large size. The mutilated toes are not regenerated; they are missing. It so happens that each of these five specimens is a representative of each of the five series differently marked. One has the innermost toe of both its anterior limb missing, while in an other specimen the outer toes of the hind-limbs are wanting. The third one had been deprived of the outermost toes of its right hind-limb, and it is not there. The gonads of all are large, fully-developed and matured.

The most convincing example, however, is a grown up, gravid female. In each of her two oviducts there are fully-matured, large, shelled, white eggs ready to be laid. As recorded in our notes, she is one of a series of young ones that hatched in the laboratory between 7 p.m. of September 5, and 9 a.m. of September 8, 1929. When recovered from the college compound and killed at 4 p.m. on July 11, 1930, she was about ten months and three to six days old.

This leaves no doubt that the young of *Calotes versicolor* attain sexual maturity nine to twelve months after they have emerged from the eggs. The young that have hatched in a particular breeding season grow to be parents and lay eggs in the succeeding breeding season.

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EDITORIAL.

As this is the first number of the Journal to be published in 1931, we naturally think of the prospects before the Society in 1931. How will they compare with 1930 and what does the future hold out ?

Economy in working and reduction in expenditure rather than increase in (taxation) subscription should be our aim just as we should like it to be the aim of Government, but on making out the budget for 1931, we were horrified to find that we were faced with an increase in salaries of some Rs. 5,000 over the amount paid in 1930. Enquiry showed that the amount in question did not mean any increase in the salaries our staff had been drawing but that we had no kind friends in sight at the moment who would employ members of our staff in Field work as they did in 1930, when Mr. A. S. Vernay, engaged Mr. La Personne for 4 months and Mr. Baptista for 7 months—Eastern Ghat Expedition. The American Museum of Natural History engaged Messrs. McCann, Sawardekar and Gilbert for two months.

We have the " Field " in view.

SURVEY OF THE DECCAN.

The Eastern Ghat Scientific Survey has had to terminate its activities owing to want of funds but the work accomplished has been of great value. Mr. Whistler, writing of the Bird collections, says " I have worked partly through all the Survey specimens contained in the first volume of the *Fauna* and with most of them one comes up against the fact that we know nothing about the Deccan proper. In mapping out the distribution of even the commonest birds their distribution is obscured by our absolute ignorance of this area ".

Mr. La Personne, who was collecting in the Eastern Ghats and looks after the Society's bird collection, tells us " I have been through the Society's collections and cannot find a single specimen from the High Tableland between the Eastern and Western Ghats. For the first Natural History Society in Asia this is lamentable ". He is against destructive criticism and so puts before us a plan by which our ignorance of the avifauna and mammalian fauna of the Deccan can be remedied. He appeals to every member to subscribe Rs. 5 (or more !) to the " Deccan Survey Fund ". By this means, our knowledge of the Fauna of India will be increased and the Society's payments from ordinary revenue on account of salaries decreased. We shall not employ extra men and we hope for considerable assistance from H.E.H. The Nizam's Government.

THE JOURNAL

We are economizing as regards the number of Journals we are having printed, though this may prove bad policy in years to come and will not effect an appreciable reduction in cost, We find it difficult otherwise to reduce expenditure on the Journal. It is what makes the Society attractive and its work known to most of our members. We are giving more coloured plates, more black and white illustrations and more popular papers than ever before. We must do so if we are to attract new members and so minimize the continuous drain of members who resign either because they retire on pension or because the present financial situation has hit them hard. The value of the Journal as an advertising medium is indicated in a letter received from a member who says " I write to thank you and the Society very much for the advertisement. All the volumes have been purchased."

MEMBERSHIP.

In 1930 we received from ordinary members of the Society Rs. 2,000 less in subscriptions than in 1929. Will members come to our help and do their utmost to bring in new members? We are a Mutual Society, we have no agents paid a commission to get new members. We have no Endowments as some old established Societies have. True we have investments, but these represent our liabilities to Life Members and our reserves for publications.

BEQUESTS.

We hate to lose members by resignation—we hate still more to lose old friends through death, but we see several Societies draw the attention of their members to a Form of Bequest and we therefore for the first time publish a Form of Bequest which we hope may be of use several years hence, but not in 1931.

ILLUSTRATED CHARTS OF COMMON INDIAN BIRDS.

We would draw the special attention of members to the advertisement on the cover of this Journal relative to our latest publication—Coloured Charts illustrating no less than 210 of the Commoner Indian Birds. The charts have been designed primarily for the use of schools but they will also be of great utility in Clubs and Institutes and Officers' Messes and, until we are able to make further use of the blocks, of use to individual members. We are offering these charts to members at the same price as we are supplying Schools and Colleges—that is at the cost price to the Society.

We write " until we are able to make further use of the blocks". The production by the Society's own artists of these coloured illustrations was intended to serve two purposes. First, to supply at cost price charts for instructional purposes in Schools and other Institutions and then, when the sale of the charts had paid for the cost of the blocks, for the use of those blocks free of cost, except for the cost of printing, in connection with a book on the Common Birds of India which the Society would issue on the lines of the *Book of Birds* published by the Geographical Society of America.

We have not given vernacular names of the birds illustrated on the charts. Vernacular names vary so greatly that it must be left almost to the School children themselves to give vernacular names. It will be interesting to see if they distinguish between different species. The charts, of course, do not give written descriptions and there is little doubt that the publication of these charts will stimulate the demand for a book which gives not only numerous illustrations but also, in non-scientific language, descriptions of the birds and their habits. Hitherto, the cost of a book containing 210 coloured and accurate illustrations would have been prohibitive, but if we realize from the sale of these charts the money expended on them we shall be able to issue such a book, the MS. of which is already in preparation, at a cost of about Rs. 10.

Some of the illustrations in the charts have already been put to use in a book, as 44 of them were selected to illustrate a book written by Messrs. Baker and Inglis on the Birds of Madras and published by the Madras Government. It is a pity that the book was published before the results of the Society's Survey of the Eastern Ghats were made known and that criticisms which had appeared in our Journal of the various volumes of the 2nd Edition of *the Fauna of British India*, *Birds*, which the authors have adopted for their guidance, have not been made use of. We are glad, however, that our Society has been able to help in the publication.

THE INDIAN GAME BIRD VOLUMES.

A good many of our members are now in possession of the third volume of Stuart Baker's excellent series on the *Game Birds of India* and we are glad to say that the publication of the 3rd volume has stimulated the demand for the first two. Certainly the terms offered to members for the purchase of the three volumes are such as to make it worth while becoming a member of the Society merely to obtain such splendid books on such favourable terms. The publication of the 3rd volume has however done more. It has caused the printers to ask " What about the publication of the fourth volume, that dealing with the Partridges and Quails ? These are of far more interest to the average member in India than the Pheasants". Partridges and Quails so to speak are, like the poor, always with us and as we like to be able to distinguish between the worthy and unworthy of the poor, so we want to know something definite and helpful about the Partridge and the Quail we are likely to shoot and eat.

The members themselves must give the answer to the publishers. We must be able to pay the publishers for the first three volumes and make a little profit for the author before we start on another venture which means a change in investment from Government Securities to books which either do not bring in a return or are eaten by termites!

We hope shortly to publish Capt. Bates' book on *Bird Life in India* as the replies to the prospectus issued, have been sufficiently favourable to warrant publication.

In the next issue of the Journal we shall publish a note by Mr. W. S. Millard on the foundation of the Society. We are sorry to have had to omit from this number Father Blatter and Mr. Millard's serial article on *Some Beautiful Indian Trees*, but the coloured plates will not arrive from England in time for this Journal. We have also been compelled to omit Mr. Whistler's interesting serial on the "*Study of Indian Birds*". The MS. arrived too late for inclusion in this number.

THE TOXICITY OF THE VENOMS OF INDIAN SCORPIONS

PROGRESS OF THE SOCIETY'S INVESTIGATION

Scorpion Venom

		Number of Scorpions	Weight of dry Venom in milligrams.
Butheolus bicolor	...	1	0·0
,, *melanurus*	...	5	0·0
Buthus acute-carinatus	...	1	0·0
,, *alticola*	...	1	0·0
,, *australis*	...	3	2·0
,, *pachyurus*	...	57	25·5
,, *rugiscutis*	...	20	10·7
,, *tamulus*	...	394	872·9
Iomachus laeviceps	...	1	0·0
Isometrus europaeus (*vesicles*)	...	10	7·0
Palamnaeus bengalensis	...	2	9·7
,, *fulvipes*	...	59	215·8
,, *gravimanus*	...	4	14·6
,, *liurus*	...	20	13·6
,, *longimanus*	...	5	18·5
,, *phipsoni*	...	16	74·8
,, *swammerdami*	...	52	786·6
,, *xanthopus*	...	5	16·3
Scorpiops asthenurus	...	5	5·6
,, *montanus*	...	7	3·6

Pharmacological Laboratory,
Parel, Bombay.
September 17, 1930.

J. F. CAIUS.

MISCELLANEOUS NOTES.

I.—WANTED BEARS!!!

It has been suggested to me that an article on Indian Bears—on the lines of the articles on the Tigers, Panthers and Lions already published in this *Journal,* might prove interesting to Indian Sportsmen and Naturalists. Since I should like to make the account as complete as possible, I venture to appeal to the kindness of the members of the Society for help in various particulars.

In the first place, the British Museum has hardly any specimens of the Himalayan Red Bear; and skins and skulls of both sexes from various localities are very much needed to show its variations with age, sex, season, altitude and locality. It is not even known whether this bear is merely a local race of the European Brown Bear or a distinct species.

Of the Himalayan Black Bear and the common Sloth Bear of Peninsular India, specimens would also be acceptable. There is probably much to be learnt about the local variation in these two widely ranging species. It was not until recently, indeed, that the examination of a skull of the Sloth Bear—presented by H.H. The Maharajah of Gauripur—convinced me of the existence of this species in Assam.

From the Shan States a race of the Brown Bear has also been recorded; but of this practically nothing is known except a single skull.

Even of the little Malayan Bear, examples are badly needed, especially from Tenasserim, Burma and farther to the north in the eastern Himalayas and Assam; and confirmation of its reported occurrence at Darjiling would be interesting.

I should be most grateful for the donation or loan to the British Museum of any specimens of Indian Bears or for any information, regarding their overlap in range, with which sportsmen could supply me.

British Museum (Nat. Hist.), R. I. POCOCK.
London, S. W. 7.

II.—ON THE FOOD OF THE VAMPIRE BAT (*LYRODERMA LYRA*).

One night last month, while staying at the Residency, Rajkot, I was on my way upstairs to dress for dinner, when my attention was attracted by something unusual in the appearance of one of a pair of bats hanging from the ceiling above the staircase. Looking closer, I found that, suspended from the mouth of the bat which held it by the head, was a fair-sized lizard!

I watched to see how the bat would tackle a meal of this kind. The method was soon apparent. Never letting go his hold of his prey he scrunched and scrunched away until the head was reduced to a condition which made it possible for him either to begin to swallow his prey as a pulpy whole or to detach and swallow a portion. Whichever it was, the progress of that lizard into the bat's interior continued very slowly, but steadily.

Here I had to go and dress as speedily as might be. Returning after twenty minutes, I found that the meal had advanced as far as the forelegs; the forefeet of the lizard were only just visible, the rest of the body and hind legs still hanging down. I could not unfortunately see the performance through as I was dining out and had to go. But I invited the attention of others of the house party who afterwards informed me that, at the end of dinner three-quarters of an hour later, the tip of the lizard's tail alone was still visible.

On my return about midnight, the bats were still there, engaged in bowing to each other rather after the manner of an inverted Punch and Judy. On the staircase below, I found one foot and half the head, sole remains of the victim, but sufficient to enable me to identify it as a common house gecko, quite a large specimen. Apparently the whole of the gecko, with the exception of these two fragments, had been consumed.

I may mention that while the meal was going on—a gruesome performance—the second bat made several attempts to obtain a share but was not allowed a look-in. All it succeeded in doing was to force its mate to fly with its prey to a different position on the ceiling.

The bat was of medium size, white below and with large ears. I suppose *Lyroderma lyra,* which is known to capture small birds, but I have never heard of its preying on a lizard. Aitken, however, in *Tribes on my Frontier* seems to imply that it will catch and devour mice and frogs.

Bhavnagar, A. H. E. MOSSE,
September, 1930. *Lieut.-Colonel, I.A.*

[The Indian Vampire Bat (*Lyroderma lyra*)—we have a second species, the Malay Vampire Bat (*Megaderma spasma*)—appears to have a comprehensive diet which includes insects, smaller bats and frogs; even the remains of a fish have been found among the litter of bones left by a colony living among the rafters of a bungalow. The dentition of these bats is indicative of a carnivorous rather than an insectivorous diet. Though named Vampire bats, they have no connection with the true Vampire or blood-sucking bats of which there are two genera confined to South America. One of these, *Desmodus rufa,* is armed with large canine and sharp canine-like incisor teeth designed for attack. The bore of the bat's gullet is so small that nothing but liquid food will pass down it while its stomach, in form, is scarcely distinguishable from the intestine. Eds.]

III.—THE STRIPE-NECKED MUNGOOSE (*HERPESTES VITTICOLLIS*).

Sometime ago the Hon. Secretary asked me for red Mungooses. I forward the skin and skeleton of one. The beast was killed on September 18, 1930, by my dogs on the banks of a small thickly-bushed stream in the Kundahs at an elevation of 7,500′, my attention being drawn to its capture by its loud cries. After the tussle I found the coats of all three dogs reeking with a musky scent which persisted for some time in spite of their rolling in the water, presumably from the mungoose's urine. It was an old male with very worn teeth, and the largest I have ever seen. The bare patch of skin round the arms is curious. Measurements are as follows:—

Tip of nose to base of tail (measured straight) ...	20½″
Tail (excluding hairs at tip)	13½″
Girth behind the shoulder	12″
Girth of neck	8″

Colour of eye (after death) yellow orange.

WALMER, LOVEDALE
NILGIRIS, S. INDIA,
September 30, 1930.

E. G. PHYTHIAN ADAMS,
Major, I.A. (*Retd.*)

[The Stripe-necked Mungoose is the largest of Asiatic Mungooses. Little is known of its habits. Much may be done by readers of this *Journal* in recording notes on even quite common Indian animals about which we really know so little. Notes on their particular haunts, their food and methods of obtaining it, breeding habits, behaviour, etc., if recorded in these pages will gradually build up the information which is wanted. Major Phythian Adams' note reveals a possible method of defence in this Mungoose. The action may not have been voluntary but it is a type of behaviour which is popularly associated with the Wild Dog to which Mr. Morris refers in a following note. Lt.-Col. Frere's note on the breeding habits of a Common Mungoose which lived in a semi-domesticated condition in his bungalow is an instance of the value of recording observations. It gives authentic information on the breeding habits of a common and widely distributed animal in India about which nothing was known. EDS.]

IV.—THE INDIAN WILD DOG (*CUON DUKHUNENSIS*).

I was interested to see recently at Messrs. Theobald Bros' premises in Mysore two full-grown wild dogs—a dog and a bitch—and to notice that both were quite tame, although displaying nervousness at first on the approach of a stranger. On my approach, one of them uttered that peculiar chattering noise which wild dogs often make when suddenly startled: the other went into a corner, with its tail between its legs and proceeded to urinate over it. There was however no indication that this action was due to anything but nervousness, nor did the dog's urine give out any offensive odour, contrary to the widely spread belief among jungle tribes that a wild dog will blind its pursuer in this way. The dogs were remarkably free from any smell, as also was their breath. I think Mr. Theobald informed me that he fed them twice a day—a meal of bread and milk and one of meat—though of this I am not sure. The dogs had a curious habit of pulling things to pieces when free—not excepting leaves and stalks of ornamental plants in flower pots, etc. It would be interesting to learn the maximum number of cubs (pups) that have been found in a wild dog's litter. I believe there is a case on record of five having been found.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
Via MYSORE,
S. INDIA,
October 3, 1930.

R. C. MORRIS.

[*Robinhood* in an article in the *Pioneer* which was reprinted in our *Journal,* Vol. x, p. 127, mentions taking six pups in a wild dog's litter. Blanford states that 'there are sometimes six or more in a litter.' Hodgson places the usual number as between two and four. The breeding season is given as between January and March. Prof. H. Littledale (*Journ. Bom. Nat. Hist Soc.,* Vol vii, p. 494) records the taking of pups in April and May. Further data as to the breeding season is required. Nothing accurate is known as regards the period of gestation, which is believed to be about two months. EDS.]

V.—MEASUREMENTS OF A LARGE INDIAN WOLF (*CANIS PALLIPES*).

I am directed by the Heir-Apparent of Dewas Senior to forward to you the following particulars for the use of your *Journal* which I trust will be of interest to you.

On July 30, 1930, the Heir-Apparent shot a very fine specimen of a male wolf near Umadi in Jath State. It measured 4 ft. 10 inches from the tip of its nose to the tip of the tail and was 2 ft. 4 inches high at the shoulder. The biggest wolf recorded in the *Indian Field Shikar Book* is 4 ft. 6½ inches long. Hence the wolf shot by the Heir-Apparent is the biggest yet recorded in India.

The pair of the above, a fine female, measuring 4 ft. 5 inches long from nose to the tip of tail and 2 ft. 1½ inches high at the shoulder, was shot at the same time by Meh. Y. D. Ghorpade, Jahagirdar of Madbhavi.

KHOLAPUR,
September 14, 1930.

R. Y. CHAVAN,
Private Secretary to the Heir-Apparent of Dewas Sr.

VI.—COURAGE AND COWARDICE OF THE HYÆNA

The interesting accounts of the pluck and cowardice of hyænas in your *Journal,* Vol. xxxiv, No. 2, reminds me of two occasions, which may be of interest, The first was an instance of cowardice. A very big hyæna came along to where I had a small goat tied up in a narrow nullah, in the hopes of enticing the local panther. For half an hour, or thereabouts, I watched the hyæna trying to pluck up the courage to demolish the goat. He repeatedly started a rush, but always pulled up before reaching the goat, which very pluckily faced the hyæna, with head down. Eventually, I frightened away the hyæna and, as the panther never materialized, I am glad to say the plucky little goat got its freedom.

The second is an instance where a hyæna not only started to eat a fresh tiger kill, but actually dragged the carcase away; how far it would have taken it I don't know as, thinking it was a tiger, in poor moonlight, I shot the beast. Very shortly afterwards I heard the steps of what sounded like the tiger which went round and round the kill, out of sight, and then made off.

On more than one occasion have I seen hyænas eat a tiger or panther kill. I was rather led to believe at one time that when a hyæna came and ate a tiger or panther kill, it was a sign that the owner of the carcase would not turn up, but it seems by no means to be the case.

Fort Lockhart, N.W.F.P.,
September 12, 1930

C. W. SANDERS,
Major.

VII.—MEASUREMENTS OF BIG GAME.

Brown Himalayan Bear (*Urusus isabellinus*); old female.
Shingoshigar, September 1, 1930.

Length over curves	60″
Girth (chest)	40″
Height at shoulder	27″

Black Himalayan Bear (*Selenarctos tibetanus*); big male.
Pir Panjal, October 16, 1930.

Length over curves	70″
Girth (chest)	47½″
,, (neck)	35″
,, (head in front of ears over big jaw muscles)	30″
Height at shoulder	27½″

Tibetan Antelope (*Pantholops hodgsoni*).
Ning Rhi, Changchamo, July 7, 1930.

Horns	33½″
Height at shoulder	32½″
Girth (chest)	33½″
,, (base of neck)	17″
,, (throat)	13½″

Srinagar,
October, 1930

C. H. STOCKLEY,
Lt.-Col.

VIII.—DRUMMING SOUND MADE BY LEOPARDS.

In the numerous articles and books on big game shooting I have seen, I have not heard any mention of a curious sound that a leopard often makes as he, or she, lies near the kill but is too suspicious to venture in. This is a beating on the ground—like the stamp made by a rabbit at home outside his burrow. It is done with the tail I fancy though I have not actually seen it done. The Burmese know it well and tell me it is done by a sharp blow with the tail which is rigid at the time—the under surface of the tail hitting the ground, not the end of the tail but the basal half of it. A single blow is usually given and is so characteristic that once heard will not be forgotten; after an interval of perhaps 4-10 minutes it will be repeated if the leopard is still there. On such occasions I have not been successful—it is a bad omen—and no doubt the leopard is gazing up at the machan!

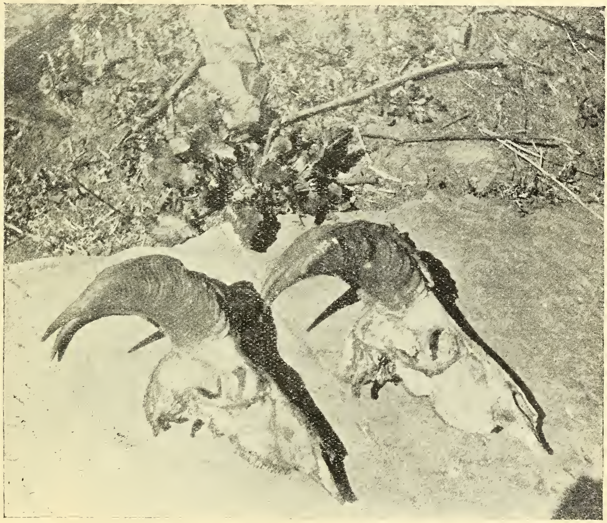
I should be interested to hear more about this if someone will tell us, and also if the Tiger or the Lion does the same.

Haka, Chin Hills, T. R. LIVESEY.
July, 1930.

IX.—MALFORMATION IN SKULL OF A THAR (*HERMITRAGUS JEMLAICUS*).

(*With photograph*)

The accompanying photograph shows the skulls of two Thar which I shot recently in Pangie, N. Chamba within half a mile of each other.



After removing the mask and meat from the skull on the left, I was surprised to find a large indentation running from between the base of the right horn and eye diagonally across the middle of the forehead to the left eye.

The indentation, measures 2 inches across the widest part and in the middle the surface of the bone is depressed to the extent of half an inch below the normal contour. The difference can be seen by comparing the two skulls in the photograph. No trace of fracture of the skull is apparent and there is no corresponding bulge or exostosis. The distance from the front of the brain cavity to the 'foramen magnum' in the malformed skull is 4·5 inches, whereas that in the other skull is 5 inches.

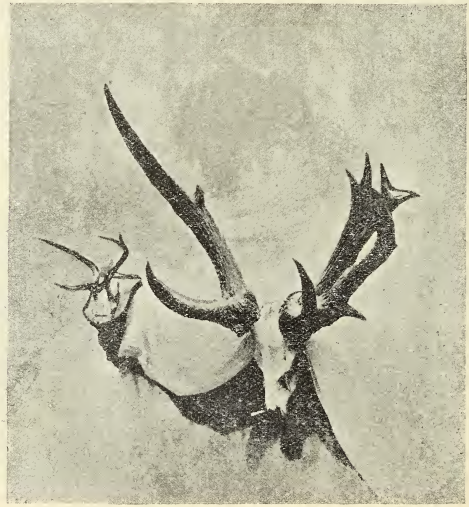
It is clear that whatever accident may have caused this malformation it must have occurred when the animal was very young or perhaps even in the fœtal stage. The resulting pressure on the brain, one would have thought, would have either stunted growth or intelligence; yet it carried a good average pair of horns and was considerably larger in body than the other Thar whose horns were slightly longer, while during the stalk the animal certainly displayed no lack of intelligence with regard to its personal safety.

HODSON'S HORSE,
KOHAT,
N.W.F.P.

R. K. M. BATTYE,
Lieut.

X.—ABNORMAL HORNS OF SAMBUR (*CERVUS UNICOLOR*).

(*With a photo*)



ABNORMAL HORNS OF SAMBUR. BEHIND IS THE HEAD OF THE 'PIGMY' BROW-ANTLERED DEER REFERRED TO IN THE NEXT NOTE.

I saw these abnormal horns in the house of Colonel A. L. Bacon, at Mogok, and took the accompanying photograph of them which I send, with Colonel Bacon's permission, for reproduction in the *Journal.*

The sambur head was found by a cartman when looking for his strayed bullocks in the jungles of the Mogok Forest Division, Upper Burma.

The measurements are :—

Right horn—37½ inches long, 15½ inches in girth. Points practically normal.

Left horn—27 inches long, 17¼ inches in girth. Seven points.

The horns must be abnormally heavy. I was unable to weigh them. This stag may have died a natural death, or have been killed by a tiger. As the body of the animal was not examined, it can only be conjectured that there was some injury to the generative organs.

COONOOR,
August, 1930.

R. W. BURTON,
Lieut.-Colonel,
Indian Army
(*Retired*).

XI.—A VARIETY OF THE THAMIN OR BROW-ANTLERED DEER (*RUCERVUS THAMIN*).

The thamin was shot in Lower Burma, below Prome. It is known locally (neighbourhood of village Shwedaung, which can be got at by motor from Prome) as the 'Shwe', or Golden Thamin. It is, Colonel Bacon says, a distinct type thereabouts, and is a much smaller animal than the normal brow-antlered deer, being only somewhat larger than a barking deer. The villagers say they are scarce, and only found in the low country.

The measurements of the horns in the photograph, published with the preceding note on the sambur, are :—

Main horn—12¾ inches in length.

Brow tine—5½ inches in length.

The horns are perfect in shape and proportion, and of the normal type of the brow-antlered deer of the same part of Burma, but in diminutive form.

It would be very interesting if a member of the Society would make an opportunity to collect the skin and skeleton of one of these diminutive stags for examination at the Society's Museum, as there is no mention of a sub-species of thamin in any scientific work on the mammals of Burma.

I have just seen, in the house of a friend here, the diminutive horns of a chital stag. It was shot in the United Provinces. The animal was of full size and in no way dwarfed. The skull is as large as that of a 37-inch stag.

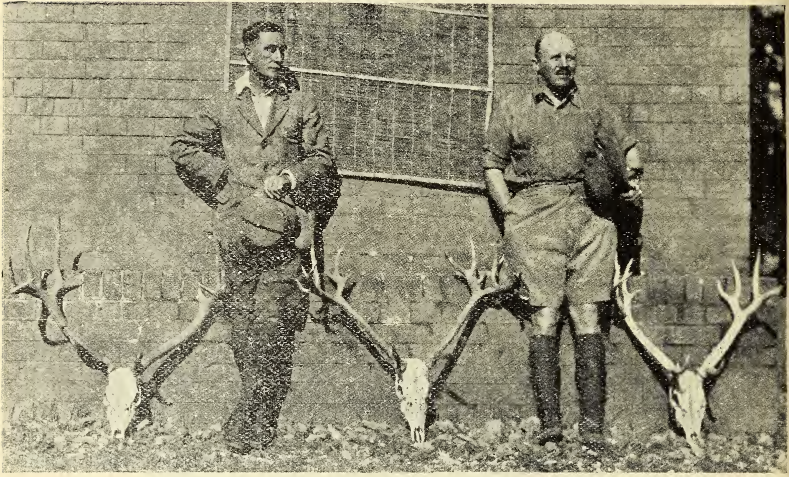
COONOOR,
August, 1930.

R. W. BURTON,
Lieut.-Colonel,
Indian Army
(*Retired*).

[Two sub-species of Thamin are recognized from Burma. *R. thamin thamin* of which the type locality is Pegu and *R. thamin brucei* from the Ruby Mines, Burma. The distinction between the two races is based on the character of the antlers. EDS.]

XII.—SWAMP-DEER (*RUCERVUS DUVAUCELLI*) HEAD WITH NINETEEN POINTS.

(*With a photo*)



In December last, in the Kheri District, I shot a *gond* with nineteen points. I should be obliged if you would kindly let me know if this is a record as regards the number of points.

I have made enquiries, but I have not up-to-date heard of one with more than 17 points. The head in question is the centre one in the enclosed photograph. All 19 points can be counted easily although those against my 'shorts' do not show up quite so well as the others.

Police Training School,
Moradabad, *U.P.*,
July 1, 1930.

R. POWELL,
Indian Police Service.

[The late Rt. Hon'ble E. S. Montague had a Swamp-Deer head with 11 + 9 points. Like Mr. Powell's, it was shot in the Kheri District. The record head measures 41″ and has 8 + 5 points. Swamp-Deer display considerably variation in their horns. There are two distinct types. In one, the horns are not unlike those of a sambur and as limited in the number of points. The second type has spreading antlers whose tines throw off a number of branches. Between these two types all intermediary stages are found. Eds.]

XIII.—THE OCCURRENCE OF THE GREY HYPOCOLIUS (*HYPOCOLIUS AMPELINUS*) IN NORTH KONKAN.

On November 14 (1930), I shot a male specimen of *Hypocolius ampelinus* at Kihim, Kolaba District. This bird, whose distribution is Persia, and which is found also in Bushire, Fao and other places on the shores of the Persian Gulf, seems never to have been recorded within Indian limits save (once?) as a very rare straggler on the Sind-Baluchistan border.

Its occurrence in the Konkan seems extraordinary. The specimen was solitary. While it is possible that it is an escaped cage-bird, its perfect plumage certainly bears no traces of recent captivity.

The bird was first seen amongst the bare thorny branches of a fallen Babool tree near a tidal creek, whence it once flew out to the ground a short distance away after an insect (?) exactly in the manner of a shrike, and returned to its perch. It appeared tame and fearless, allowing me to approach within a few feet as it sat fluffed out and low down on a branch.

A little later when I returned with the gun, it was still in the neighbourhood in a thick tangle of Lantana bushes, on the berries of which it was busy feeding in company with *Sturnia malabarica* and *Turdus m. nigropileus*. The stomach and intestines exclusively contained Lantana berries; 33 seeds were removed including some on the point of being excreted. Testes very small. Wing 98 mm.; bill 15 mm.; tarsus 22 mm. Upper mandible horny-black, lower flesh colour with dark tip; legs, feet and claws brownish flesh colour. Iris brown.

KIHIM,
KOLABA DISTRICT,
November 20, 1930.

SALIM A. ALI.

XIV.—COURTSHIP OF THE SCARLET MINIVET (*PERICROCOTUS SPECIOSUS*).

The Scarlet Minivet is extremely common in the Naga Hills and may be seen moving about in large parties among the branches of low trees. On one occasion, about the end of February, I observed a pair of these birds hopping about in the branches as though they were courting. Of a sudden, I noticed the female fly off and go high up into the air; a second later, the male gave chase and before long caught her up and seized hold of the tip of her tail with his bill and in this attitude both of them came whorling down like a 'plane spinning'. Before reaching the earth the male released the female and both returned to the tree where they had been. Here they once more went through a series of hops on a branch and then, of a sudden, the female launched out into the air again to be pursued by the male and the same antics were repeated. When launching out into the air the female gave a feeble whistle, but the descent was always silent.

Bombay Natural History Society, C. McCANN.
6, Apollo Street,
October, 1930

XV.—DESCRIPTION OF AND NOTES ON THE FEMALE CHESTNUT-MANTLED KOKLAS (*PUCRASIA M. CASTANEA*) FROM CHITRAL

We are greatly indebted to Lt. J. A. S. Roper for the above-mentioned specimen received in August, 1930, from Kila Drosh and also for his interesting notes on this bird.

Description.—The female of *P. m. castanea* differs from the female of *P. m. macrolopha* in its general paler tone.

The whole head is greyish-brown with crescentic bars and centres of feather buff; the crest with broad buff centres. Supercilium well defined creamy buff, flecked with grey above the eye. The feathers of the upper back are not so dark as in *P. m. macrolopha,* and are broadly tipped with grey, paling towards the lower back and rump. The general colour of the tail is blackish-brown, not rufous buff as in *P. m. macrolopha;* the central tail feathers are greyish-brown.

The following are Lt. J. A. S. Roper's Notes on the species:

Distribution.—'Mainly in Kafiristan', writes Lt. J. A. S. Roper; 'but is found in the southern nullahs of Chitral which lie to the west of the Kunar river. It may spread across the river on the south-western portion of the Hindu Raj Range but this is doubtful. 3,000—7,000′ in winter and 7,000—10,000′ in summer.'

Nidification.—'Eggs are laid during May. The nesting site is usually placed on a ledge on some difficult piece of cliff towards the top of a nullah'.

Habits.—'It is usually found singly during winter on the sides of nullahs. It lies very close, but if put up flies strongly. The call, uttered usually in the mornings, is a *kuk-uruk-uruk* very much resembling the call of the jungle-fowl but with a hint of the black partridge. It is particularly noisy during March and April (presumably just previous to the mating season)'.

Fulton also records, (*J.B.N.H.S.*, Vol. xvi, p. 61) the striking resemblance of the call to that of the jungle-cock.

Bombay Nat. Hist. Society, V. S. LA PERSONNE.
October, 1930.

XVI.—CASUALTIES AMONG THE EGGS AND YOUNG OF SMALL BIRDS.

Every egg collector in India must, at one time or another, have been struck by the all-too-frequent disappearance of eggs and young from nests he has had under observation. The enormous extent of the damage which is in a great measure due to lizards, snakes, predatory birds and the common or garden ' Boy ', and to a variety of natural causes besides, is perhaps not generally realized. In some cases the destruction may naturally be less than in others, but with many species including some of our commonest, it is so great that one wonders how the birds are able to hold their own in the matter of numbers notwithstanding.

I give below a summary of several nests that I had the opportunity of keeping under more or less continuous observation during the monsoon, which conveys some indication of the appalling destruction that goes on in these parts.

Bombay Babbler. Turdoides somervillei.

22 August.	Nest on Mango graft, 12 ft. from ground. Two eggs.
29 August.	Snake climbed tree and devoured eggs. Nest deserted.

Iora. Ægithina tiphia.

Nest No. 1.	17 June.	A pair commenced building in lime tree, 8 ft.
	22 ,,	1 egg.
	23 ,,	2 eggs.
	24 ,,	3 eggs.
	25 ,,	At 6·30 P.M. all eggs gone ! Probably work of crows. Nest deserted.
Nest No. 2.	27 Aug.	A pair completing nest in Mango tree near bungalow, 15 ft.
	29 ,,	1 egg.
	30 ,,	2 eggs.
	30 ,,	At 6 P.M. both eggs missing. Nest deserted.

Red-vented Blubul. Molpastes cafer.

Nest No. 1.	12 May.	Nest in garden creeper arch, 4 ft., containing 1 fresh egg.
	13 ,,	2 eggs.
	13 ,,	Both eggs gone. Reported work of *Calotes.* Nest deserted.
Nest No. 2.	11 May.	Nest in pollarded Bhendi (*Thespesia populnea*) containing 3 chicks, about 4 days old.
	15 ,,	All 3 chicks disappeared. Probably work of boy.
Nest No. 3.	27 ,,	A pair commenced building in pollarded Guava tree, 4 ft.
	29 Aug.	Nest completed. No. eggs.
	30 ,,	1 egg.
	1 Sept.	Still 1 egg.
	2 ,,	Ditto.
		Nest deserted, probably owing to continual harassment from a pair of *Otocompsa* nesting hard by.

Nest No. 4.	28 Aug.	Completed nest in Cactus hedge, 3 ft. No eggs.
	1 Sept.	2 eggs.
	2 ,,	3 eggs.
	4 ,,	Nest empty and deserted.
Nest No. 5.	1 ,,	Completed nest in Cactus hedge in Paddy field, 6 ft. No eggs.
	4 ,,	2 eggs.
	14 Sept.	Nest empty, 'roughed up' and rain-sodden.
Nest No. 6.	4 ,,	Nest nearing completion on Casuarina branch, 8 ft.
	14 ,,	No traces of nest. Evidently blown away by heavy intervening storm.

Southern Red-whiskered Bulbul. Otocompsa emeria fuscicaudata.

Nest No. 1.	4 May.	Nest in Casuarina sapling near a bungalow, 6 ft., containing 2 chicks about 4 days old.
		Both chicks left nest safely on or about 13 May.
Nest No. 2.	3 May.	A pair commenced building in palm-leaf wall of inhabited hut, inside, 4 ft.
	8 ,,	1 egg.
	9 ,,	2 eggs.
	10 ,,	3 eggs.
	23 ,,	1 egg hatched; 2nd egg hatched at noon.
	28 ,,	At 3 P.M. Both chicks and 3rd (addled?) egg had vanished.
Nest No. 3.	15 Aug.	A pair completing nest in pollarded Oleander, 5 ft.
	18 ,,	Nest completed. No eggs.
		Later, nest deserted; reason unknown.
Nest No. 4.	18 ,,	Nest nearing completion in *karonda* bush intermixed with Cactus and Lantana, 3 ft.
	20 ,,	1 egg.
	21 ,,	2 eggs.
	22 ,,	3 eggs.
	24 ,,	Still 3 eggs.
	26 ,,	Nest empty and 'roughed up'. Work of boy as evidenced by footprints in mud.
Nest No. 5.	27 ,,	A pair commenced nest in pollarded Guava tree, 6 ft.
	1 Sept.	6-30 A.M. 1 egg; 11 A.M. 2 eggs.
	2 ,,	8-30 A.M. 3 eggs.
	5 ,,	A female Koel (*Eudynamis scolopaceus*) clung to side of nest and swallowed up all eggs two after another. Nest deserted.
Nest No. 6.	29 Aug.	Nest just being completed in Lantana bush, 3 ft.
	30 ,,	1 egg.
	4 Sept.	3 eggs.

	13 ,,	1 chick hatched (yesterday or this morning ?)
	14 ,,	Still 1 chick and 2 eggs.
	15 ,,	Ditto.
	22 ,,	Entire contents of nest vanished !
Nest No. 7.	29 Aug.	Nest in small tree inside of well, 3 feet down, containing 2 eggs.
	30 ,,	3 eggs.
	4 Sept.	All eggs gone ! One lying broken on stone under nest.
Nest No. 8.	7 ,,	Nest in small palm, 3 ft., containing 2 eggs.
	8 ,,	Both above eggs hatched.
	19 ,,	Chicks were ready to fly in a couple of days. Nest found empty in the afternoon. Both chicks gone.
Nest No. 9.	22 ,,	Nest in Hibiscus near bungalow containing 1 egg.
	23 ,,	2 eggs.
	24 ,,	Nest 'roughed up'. Both eggs gone.

Indian Wren-Warbler. Prinia inornata.

Nest No. 1.	16 Aug.	A pair busy on nest among grass stems on bund in Paddy field, 15 inches.
	18 ,,	Nest completed ; no eggs.
	20 ,,	1 egg.
	21 ,,	2 eggs.
	23 ,,	4 eggs.
	26 ,,	Nest disappeared. From footprints in mud around, evidently work of small boy.
Nest No. 2.	18 Aug.	Completed nest swung between grass stems, 12″. No eggs.
	20 ,,	1 egg.
	21 ,,	2 eggs.
	23 ,,	4 eggs.
		Nest deserted on completion of clutch, possibly owing to my tampering with it in the course of egg-substitution experiments.
Nest No. 3.	19 Aug.	Nest under construction amongst stems of Tillseed plants on a bund, 2 ft. Both birds working.
	21 ,,	Nest nearly completed.
	23 ,,	1 egg.
	26 ,,	4 eggs.
	1 Sept.	4 eggs O. K.
	14 ,,	4 chicks with quills sprouting being fed in nest by fussy and cautious parents.
	18 ,,	Nest badly mauled about. Torn open at side ; all chicks missing.
Nest No. 4.	22 Aug.	Nest under construction in Lantana clump, 4 ft. Both birds working.

	23 Aug.	Construction progressing fast.
	26 ,,	4 eggs.
	1 Sept.	All eggs gone.
Nest No. 5.	23 Aug.	Completed nest in clump of Tillseed on bund, 18″. No eggs.
	19 Sept.	3 chicks about 9 days old. Nest not visited again.
Nest No. 6.	13 Oct.	Nest in clump of grass on bund, 15″, containing 1 egg.
	14 ,,	2 eggs; owners of nest accompanied by 3 fully-fledged young of first (?) brood.
	15 ,,	3 eggs
	17 ,,	4 eggs.
	27 ,,	4 newly hatched chicks.
	30 ,,	2 chicks vanished; a third was found lying helpless on the ground under the nest, and was put back.
	8 Nov.	When nest was visited, 2 chicks fluttered out with difficulty and flew out unsteadily for a few yards. Their subsequent fate is unknown.

White-backed Munia. Uroloncha striata.

Nest No. 1.	12 Aug.	A pair commenced building in *Quisqualis* arch near bungalow, 7 ft. Both birds working.
	15 ,,	Nest completed; no eggs at 10 A.M.
	16 ,,	1 egg.
	17 ,,	2 eggs.
	19 ,,	3 eggs.
	20 ,,	4 eggs.
	21 ,,	5 eggs.
	4 Sept.	4 blind naked chicks; 1 unhatched egg Bird brooding.
	5 ,,	At 8 A.M. unhatched chick also out.
	20/21 ,,	Nest torn open; all chicks gone. Parents hopping about nervously near nest.
Nest No. 2.	9 Oct.	Completed nest in pollarded Guava tree, 4 ft. Globe placed *on* the cup of an old Bulbul's nest. Contains 4 eggs. Both parents brooding at night.
	19 ,,	7 eggs.
	24 ,,	1 chick, 6 eggs.
	25 ,,	Nest torn open on one side; contents missing!

Purple-rumped Sunbird. Leptocoma zeylonica.

Nest No. I.	12 July	A pair building on outer twig of small tree, 7 ft.
	21 ,,	Nest completed. No eggs.
	23 ,,	2 eggs.

	30 July	Nest torn open at side. Empty egg-shells found lying under nest with beak-holes. Work of Crow Pheasant ?
Nest No. 2.	31 ,,	A pair (most probably same as No. 1) commenced building on a Kot (*Feronia elephantum*) branch, 8 ft.
	8 Aug.	Nest completed.
	11 ,,	2 eggs.
	21 ,,	Still 2 eggs. O. K.
	26 ,,	At 8 A.M. 1 egg had hatched.
	27 ,,	At 8 A.M. 2nd egg had also hatched.
	11 Sept.	Both chicks left nest safely at 8-30 A.M.
Nest No. 3.	13 Aug.	Nest under construction on twig overhanging hedge of a Paddy field, 4 ft.
	16 ,,	Nest completed. No eggs.
	18 ,,	1 egg.
	20 ,,	Nest 'roughed up' and lying in a mass on the ground. Near it, in the soft mud of the flooded field were found 2 eggs intact.
Nest No. 4.	20 ,,	Completed nest on Babool tree, 7 ft. No eggs.
	29 ,,	2 eggs.
	13 Sept.	2 blind and naked chicks.
		Subsequent fate of this nest is unknown.
Nest No. 5.	21 Aug.	Completed nest in hedge dividing inundated Paddy fields.
		Entrance and interior badly 'roughed up.' Nest was deserted. 2 eggs discovered embedded in lining.
Nest No. 6.	21 ,,	Completed nest in Babool tree, 8 ft. Was 'roughed up' and on the ground underneath were found remains of a fresh egg.
Nest No. 7.	13 Oct.	Completed nest on Ber (*Zizyphus*) twig, 7 ft.
	23 ,,	Nest pulled to tatters, probably by Crow Pheasant. 1 egg gone, the other on the point of hatching, lying on ground with remains of nest.

SALIM A. ALI.

KIHIM (KOLABA DISTRICT),
20th November 1930.

XVII.—'THE ORIGIN OF MIMICRY IN CUCKOO EGGS'

Inspired by the interesting egg-substitution experiments made by my friend Dr. Bernard Rensch of the University Zoological Museum, Berlin, in an attempt to tackle the problem of the origin of mimicry in the eggs of the European Cuckoo (*Cuculus canorus*),[1] I commenced investigations on similar lines in the monsoon this year. Although my observations this season were confined only to six nests, I am publishing the results in the hope that other members of the Society who have opportunities, may be tempted to conduct similar experiments. Dr. Rensch is one of those who believe that similarity between Cuckoo eggs and those of its various hosts is brought about not by some mysterious or conscious ability on the part of the former to lay eggs 'to order', so to say, approximating in colour and markings to those of the host, nor by the alleged intelligence of the parasite to fly about from nest to nest carrying its own egg in its bill, comparing it with the clutches of its various hosts and depositing it amongst the eggs that bear closest resemblance to its own! He believes indeed that all the discrimination and selection is exercised exclusively by the hosts. Only such cuckoo eggs as approximate in appearance to those of the hosts succeed in being accepted, while those that are obviously strange are either cast out or not incubated at all (i.e. the nests are deserted). This manner of selection has evolved distinct groups amongst the cuckoos, (each group laying a distinct type of egg) who from generation to generation resort for egg-laying only to the nests of such species as they themselves were fostered by. The selection exercised by the hosts, which destroy all eggs of strange appearance, ultimately tends to the 'survival of the fittest'; in other words it conduces to perfecting the resemblance between the eggs of the parasite and those of its host.

Experiment I

The Indian Wren-Warbler (*Prinia inornata*)

20. viii. 30: Nest with one egg. At 10 a.m., added 1 egg of Purple-rumped Sunbird (*Leptocoma zeylonica*). Withdrew some distance and watched through field glasses. At 10.5 a bird came and entered nest. A few seconds later it flew off. Returned again in a few minutes, entered nest and left 3 or 4 seconds later. Did not seem perturbed.

21. viii. 30: At 9.30 a.m. nest contained 2 eggs of *Prinia* and 1 *Leptocoma*.

24. viii. 30: At 9 a.m. nest contained 4 *Prinia eggs*. *Leptocoma* egg gone!

26. viii. 30: Nest contains 4 *Pirinia* eggs. Birds brooding

Result : *Leptocoma* egg accepted for first (2 or 3?) days, but discarded subsequently. Bird continued to brood its own clutch till nest destroyed by grass-cutters a few days later.

Experiment II

Indian Wren-Warbler (*Prinia inornata*)

20. viii. 30: Nest with 1 egg. Removed egg and substituted it by one of Red-whiskered Bulbul (*Otocompsa emeria*) not only quite

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[1] B. Rensch, Zur Entstehung der Mimicry der Kuckuckseier, Jour. f. Ornithologie 72, 1924, pp. 461–724 and
Ornithologische Monatsberichte, xxxiii, 6, November 6, 1925.

different in colour, but also nearly twice as large. Withdrew and watched. Owner came and peeped into nest; withdrew its head and looked around. Entered nest and remained within for 10 seconds. Flew off some distance to a bush. Returned and re-entered, but left again after about 10 seconds. Looked somewhat perturbed. I walked up to nest and found Bulbul egg intact.

21. viii. 30: At 8.45 a.m. nest contained 1 *Otocompsa* egg and 1 *Prinia* egg. Added 1 egg of Sunbird (*Leptocoma zeylonica*). Nest now held 1 *Otocompsa,* 1 *Prinia* and 1 *Leptocoma* eggs. Total 3. After introducing *Leptocoma* egg I withdrew to a distance and watched. One of the owners of nest came, peeped in, withdrew its head and had a good look round as if to discover the mischief-maker. Flew away but returned half a minute later with fine strip of grass and entered nest. From movements of nests it was apparent that repairs were being done. I returned to the nest a quarter of an hour later; disturbed one of the owners off. All 3 eggs safe. Owners had apparently accepted the strange eggs.

24. viii. 30: At 9.30 a.m. both *Otocompsa* and *Leptocoma* eggs had been ejected. The former was found lying on the ground immediately under the nest with a beak hole on either side. The nest now contained 3 legitimate *Prinia* eggs.

26. viii. 30: Owners not seen in vicinity of nest. Apparently deserted.

30. viii. 30: Nest has been deserted.

Result : *Otocompsa* egg substituted for one of her own was first accepted by *Prinia*. *Leptocoma* egg added after one more of her own had been laid, also accepted.

Both strange eggs were ejected on completion (or immediately before?) of own full clutch.

Prinia deserted nest on completion of her clutch.

Experiment III

Indian Wren-Warbler (*Prinia inornata*)

20. viii. 30: Half-built nest. Under construction; both birds working. Placed fresh *Prinia* egg from another nest in cup. Both owners visited nest, put their heads inside, one after the other, and flew off again to fetch further material.

21. viii. 30: At 8 a.m. construction progressing. *Prinia* egg gone! Inserted 1 *Leptocoma* egg into incomplete empty cup, and withdrew a short distance. Both birds came and resumed work. In a few seconds the male (later seen warbling from a neighbouring bush) entered the cup and came out with the *Leptocoma* egg in its bill. He flew off with this and dropped it in the adjacent flooded paddy field, about 10 yards from nest.

23. viii. 30: Nest complete. Contained 1 *Prinia* egg.

26. viii. 30: Nest contained 4 *Prinia* eggs.

14. ix. 30: 4 chicks ready to leave nest.

Result : Promptly discarded egg, both belonging to its own species and another, when placed in nest before its completion and prior to laying of its own.

Did not desert nest, but brought up its family.

Experiment IV

Red-whiskered Bulbul (*Otocompsa emeria*)

20. viii. 30 : Nest with 1 egg. Removed egg and substituted 1 of *Leptocoma zeylonica* instead. Visited nest after 15 minutes. *Leptocoma* egg gone ! Either swallowed up (?) or removed to some distance, as it was not found on the ground under nest. One of the owners was flushed off empty nest on second visit.

21. viii. 30 : At 9 a.m. nest contained 1 fresh *Otocompsa* egg.

22. viii. 30 : At 11 a.m. 2 eggs.

24. viii. 30 : Still 2 eggs. Bird brooding.

26. viii. 30 : Nest 'roughed up'. Both eggs gone !

Result : *Otocompsa* promptly rejected egg of different size and colour when substituted for the only one of her own in nest.

Experiments V & VI

Red-whiskered Bulbul (*Otocompsa emeria*)

2. ix. 30 : Nest containing 3 eggs. Added 1 similarly coloured and marked egg of *Molpastes hæmorrhous*. Total 4. Owner returned a few minutes later, looked surprisedly into overcrowded nest and seemed to hesitate a little. Soon got in and sat on all 4 eggs. She was uncomfortable at first and shifted and fidgeted about, but got settled ultimately.

5. ix. 30 : Bird on all 4 eggs till 5 p.m. A female Koel (*Eudynamis scolopaceus*) arrived at nest and swallowed up all 4 eggs in as many seconds. Before I could realize almost what was happening, she was off. I rushed out and shot the robber. Dissection showed that 3 of the eggs were smashed, the fourth being intact. This was carefully extracted, and replaced in Bulbul's nest, but the birds deserted, and the egg lay unattended all night.

6. ix. 30 : At 9 a.m. removed above egg to another *Otocompsa* nest about a mile distant, which already contained 3 eggs (clutch completed on September 1). I added this egg to the clutch, making total 4. Three minutes later, owner returned. Looked into nest, and resumed position on eggs !

13. ix. 30 : 1 egg of legitimate clutch hatched, evidently this morning. Other 3 eggs, including one from Koel's stomach—distinguishable by larger size and more purple blotching—intact. Bird sitting.

15. ix. 30 : At 9 a.m. nest still contained 1 chick, 3 eggs.

22. ix. 30 : Nest empty ! Chick and eggs have disappeared in the interval.

Result : *Otocompsa* accepted egg added to her full clutch, similarly coloured but belonging to different species. Second *Otocompsa* also accepted addition to her full clutch.

I was most anxious to see the result of the adventurous egg rescued from the Koel's stomach. Unfortunately before anything could happen, it went the way most eggs and chicks in the countryside seem to go !

Kihim (Kolaba Dist.),
October 26, 1930.

SALIM A. ALI.

XVIII.—NOTES ON THE PIED CRESTED CUCKOO (*CLAMATOR JACOBINUS*) IN ALIBAG TALUKA (KOLABA DISTRICT).

With reference to Mr. H. Whistler's article in Vol. xxxiv (pp. 27-39) of the *Journal,* drawing attention to the unsatisfactory state of our knowledge concerning the movements of the Pied Crested Cuckoo (*Clamator jacobinus*) and appealing for contributions, I give below notes from my diary relating to this bird in the country where I have had occasion to observe it this season.

24 May.—Heard for the first time this season. A pair seen; fairly quiet.

11 June.—Shot three specmiens in rapid succession, all from the same tree. At first there were only two birds on the tree, but the third arrived immediately the first fell. Dissection showed as follows :

No. 1.—Male. Testes undeveloped. Lumps of fat surrounding stomach. Contents : one soft caterpillar about 1″ long; a large quantity of caterpillar hairs; two hard brown fragments of some beetle.

No. 2.—Male. Testes undeveloped. Left somewhat larger than right. No fat around stomach. Contents : remains of one large cricket; large quantity of *Orthoptera* remains. The stomach was so tightly packed and hard, that prior to dissection it seemed as if there was an egg inside ready for laying !

No. 3.—Male. Left testis slight, right undeveloped. Much fat surrounding stomach. Contents : Remains of flying ants and small grasshoppers. Also one leathery greenish berry (?) of the size and shape of a paddy-grain containing two tiny seeds. (Later these were sown, but without result.)

It is significant that all the three birds proved to be males with their organs as yet showing no tendency to breed.

16 August.—A pair observed *in copula.* The female was swallowing a large green hairy caterpillar during the act.

26 August.—A great commotion was caused among a *'sisterhood'* of Bombay Babblers (*Turdoides somervillei*) by the visit of a pair of *Clamator* to a nest containing two eggs. The cuckoos were calling loudly and were doubtless intent on cuck-olding the Babbler. The bird sitting on the eggs gave the alarm and left the nest to chase the intruders away. The rest of the *'sisterhood',* feeding at a distance promptly rallied to the summons. There was much swearing and noise as the flock pursued the cuckoos from tree to tree and finally drove them away. The cuckoos kept calling lustily throughout the operations. The nest was examined immediately afterwards to ascertain whether the cuckoos had succeeded in their mission, but was found to contain only the two original Babbler eggs. The Babbler is an exceedingly close sitter and one wonders how *Clamator* ever gets a chance of foisting her eggs in the nest. Presumably, it must happen at times that the *'sisterhood'* is out of call, and while the attendant bird gives chase to one of the cuckoos that have approached its nest, his mate slips in and deposits her egg.

29 August.—Shot a specimen going about from tree to tree, obviously in search of a nest to lay in. Her oviduct contained a complete egg. The shell was soft and leathery, but had a pale blue tinge.

25 and 26 September.—A pair flying about noisily from tree to tree among paddy fields. The call is *piu, piu, pee-pee-piu, pee-pee-piu*—rather plaintive.

29 September.—Heard calling. Later, a pair seen following each other from tree to tree, calling loudly.

The last record for the season I have is October 15, by which date the birds had become distinctly scarce. They were quite common throughout the foregoing period, perhaps most plentiful between June 15 and the latter half of August. The specimen shot on October 15 was solitary and apparently juvenile. Male. Testes very small. Upper plumage dull dusky black; underparts strongly suffused with fulvous. Stomach contained two pieces of quartz and a couple of brown hairy caterpillars.

Since the above date, the birds seem to have completely vanished.

Kihim (Kolaba Dist.), SALIM A. ALI.
October 29, 1930.

[Writing subsequently Mr. Ali mentions that two single birds were seen on the 10th November which were doubtless young of the season. Upper parts in both sooty black; lower much suffused with fulvous. Eds.]

XIX.—BIRDS OBSERVED IN THE NEIGHBOURHOOD OF RANIKHET.

The following observations cover the period April 30 to June 11. As no collecting was done, sub-specific identifications are not attempted.

Ranikhet is not a very high Hill-station. The bungalow in which the writer was staying is about the highest, and is only 6,200 ft. above sea-level. Most of the following observations were made between 5,500 and 6,500.

The hills are, for the most part, covered with forest, the chief trees being Cheer Pine, Himalayan Oak, and Rhododendron. In addition to these, Deodar, Cypress, and Horse-Chestnut are also fairly common. The forest on the northern slopes is a good deal more open, and with less undergrowth than on the southern slopes. There is a certain amount of cultivation, particularly the Government Gardens below Chaubattia, and also a good deal of ground covered with coarse growth which was evidently under cultivation once, but which appears to have been left untouched for many years. The following birds were observed :

Corvus coronoides Gould. **The Jungle-Crow.**

This is the common crow of Ranikhet, and is found everywhere except in the thickest forest. A nest containing fully-fledged young was found about fifty feet up a pine on the edge of a clearing on May 22.

Corvus splendens Vieill. **The House-Crow.**

Only seen two or three times, always in the station itself.

Urocissa melanocephala (Lath.). The Red-billed Blue Magpie.

Very numerous wherever there are trees. Appears to breed in May. A pair were very busy picking up sticks below the British Military Hospital on May 4.

Garrulus bispecularis Vigors. **The Himalayan Jay.**

Seen occasionally, generally in pairs.

Garruilus lanceolatus Vigors. **The Black-throated Jay.**

Very numerous. At the beginning of May this species was generally seen in small parties up to about six in number. After the middle of the month, however, they were almost invariably seen in pairs.

Parus major Linn. **The Grey Tit.**

Seen occasionally, sometimes alone and sometimes in mixed flocks with other species of tits. A family of young birds which could not have left the nest more than a few days was seen on May 10.

Parus monticolus Vigors. **The Green-backed Tit.**

The commonest Tit at Ranikhet. A brood of young left their nest on April 30.

Maclolophus xanthogenys (Vigors.) **The Yellow-cheeked Tit.**

Small parties seen occasionally.

Ægithaliscus concinnus Gould. **The Red-headed Tit.**

Numerous; usually occurring in large flocks. These, flocks are occasionally mixed with other species, but are more often homogeneous. The species which seems most frequently to mix with them is *Zosterops palebrosa.* They are particularly partial to wild raspberries.

Sitta frontalis Horsf. **The Velvet-fronted Nuthatch.**

A party of three or four in a mixed flock of Tits was seen in thin forest about 6,300 ft. above sea level on May 28th.

Garrulax albogularis (Gould). **The White-throated Laughing-Thrush.**

A fairly large flock was to be seen almost daily in fairly thick forest by the path to the Dhobi Ghat on the northern slope of Chaubattia. It was seen nowhere else.

Trochalopterum lineatum (Vigors). **The Streaked Laughing-Thrush.**

Very numerous. A nest containing half-fledged young found eighteen inches from the ground in oak-scrub by the side of a main road on May 14.

Pomatorhinus erythrogenys Vigors. **The Rusty-cheeked Scimitar Babbler.**

Seen occasionally in a thickly wooded Nullah rather below 6,000 ft.

Leioptila capistrata (Vigors). **The Black-headed Sibia.**

A pair seen behaving as if they had a nest near on the edge of forest on May 9.

Microscelis psaroides (Vigors). **The Black Bulbul.**

Fairly numerous in forest. Not seen within the station, or on open or cultivated ground.

Molpastes cafer (Gmel.) **The Red-vented Bulbul.**

Fairly numerous by the road up to Ranikhet below 4,500 ft. Above that height only seen once, a small flock on open ground about 6,300 ft. on May 9.

Molpastes leucogenys (Gray). **The White-cheeked Bulbul.**

Fairly numerous within the station and on rough ground which has gone out of cultivation. At the beginning of May this species was generally seen in pairs; from the end of May onwards in family parties or small flocks.

Certhia himalayana Vigors. **The Himalayan Tree-Creeper.**

Very numerous, generally in pairs, both in gardens and forest.

Saxicola caprata bicolor (Sykes). **The Indian Bush-Chat.**

Numerous on open ground below 5 500 ft., particularly in the rough scrub below the pipe-line. By their behaviour they were evidently breeding, and a nest which appeared to belong to this species was found ready for eggs on June 7.

Saxicola torquata (Linn). **The Stone-Chat.**

Found on the same ground as the last species, but not in such great numbers. It also appeared to be breeding.

Oreicola ferrea (Gray). **The Dark Gray Bush-Chat.**

One seen in the station May 5. No other record.

Enicurus maculatus Vigors. **The Spotted Forktail.**

One seen on a stream below Ranikhet May 10, and one at Siuni, about ten miles away, May 19. Height in each case about 5,500 ft.

Chaimarrhornis leucocephala (Vigors). **The White-capped Redstart.**

One seen on a stream crossing the Kathgodam—Ranikhet road, about 4,000 ft., Apr. 30.

Copsychus saularis (Linn). **The Dhayal or Magpie-Rohin.**

Male and female seen two or three times near the Ranikhet Military Hospital in May.

Turdus boulboul (Lath). **The Gray-winged Blackbird.**

Very numerous, particularly near streams. The '*Fauna*' (second edition) Vol. II, p. 132 says 'It sings very little except in the early mornings.' During the whole time I was in Ranikhet, its voice was to be heard near every stream from daylight till about 9 a.m. and from 4 p.m. to dark. A broken egg which evidently belonged to this species was picked up on a path on May 3. In June these birds became very pugnacious, and seemed to be fighting amongst themselves whenever seen.

Arceuthornis viscivorus (Linn). **The Missel-Thrush.**

Fairly numerous in forest above 6000 ft. throughout May and June. Young birds were seen leaving a nest in an oak about 6,200 ft. on May 19.

Oreocincla dauma (Lath). **The Small-billed Mountain-Thrush.**

One seen in the station about 6,000 ft., May 25

Monticola cinclorhyncha (Vigors). **The Blue-headed Rock-Thrush.**

Very common on open ground and in light forest. Many more males than females seen. A young bird which could not have left the nest more than a day or two seen June 6.

Monticola solitaria (P. L. S. Müller). **The Blue Rock-Thrush.**

One female seen below Ranikhet, about 5,000 ft., June 11. No other record.

Myiophoneus temminckii Vigors. **The Himalayan Whistling-Thrush.**

Seen on every stream which contained water above 2,300 ft. between Kathgodam and Ranikhet.

Cyornis tricolor (Hodgs). **The Slaty-blue Flycatcher.**

One seen near the top of Chaubattia, about 7,000 ft., May 11.

Cyornis superciliaris (Jerdon). **The White-browed Blue Flycatcher.**

Fairly numerous in the earlier part of May, but much less so towards the end of the month and in June.

Stoparola melanops (Vigors). **The Verditer Flycatcher.**

Fairly numerous, and appeared to be breeding.

Alseonax latirostris (Raffl). **The Brown Flycatcher.**

Occasionally seen, generally in the station.

Hemipus picatus (Sykes). **The Pied Shrike.**

One seen in Govt. Gardens, Chaubattia, June 4. No other record.

Pericrocotus brevirostris (Vigors). **The Short-billed Minivet.**

Common wherever there are trees. In May this species was almost always met with in pairs. From the beginning of June they were generally in small flocks.

Dicrurus macrocercus (Vieill). **The Black Drongo or King-Crow.**

Fairly numerous.

Dicrurus leucophæus (Vieill). **The Ashy Drongo.**

Numerous wherever there are trees. A pair had a nest about twelve feet from the ground in a pine tree in the compound of the house in which I was staying. The young birds left the nest on June 8. While the young birds were still in the nest, the old birds were seen to attack and drive away Crows, Kites, Mynahs, Scavenger Vultures, and a Red-legged Falconet.

Seicercus xanthoschistus (Hodgs). **The Grey-headed Flycatcher-Warbler.**

Very common. A brood of young which could not have left the nest earlier than that day were seen at Siuni on May 18. From that day on, young birds were seen everywhere.

Oriolus oriolus (Linn.). **The Golden Oriole.**

One seen in the grounds of the Ranikhet Military Hospital, May 3, No other record.

Acridotheres tristis (Linn.). **The Common Mynah.**

Common and breeding. Nests containing young found from May 18 onwards, and a nest containing eggs on June 7. The latter was in a hole in an oak; all the rest in buildings.

Æthiopsar fuscus (Wagl.). **The Jungle-Mynah.**

One seen in scrub below the pipe-line about 5,700 ft., May 23 No other record.

Gymnoris xanthocollis (Burton). **The Yellow-throated Sparrow.**

Several seen in gardens on May 1, but none seen after that date

Passer domesticus (Linn.). **The House-Sparrow.**

Fairly numerous in the bazaar, not often seen elsewhere.

Passer rutilans (Temm.). **The Cinnamon Tree-Sparrow.**

Very numerous, both round houses and in the more open forest. They were busy building at the beginning of May, and some were seen carrying nesting materials as late as the second week in June. There were three nests under the eaves of the house in which I was staying. One brood hatched out on June 6.

Delichon urbica (Linn.). **The House-Martin.**

One seen June 2. No other record.

Hirundo daurica Linn. **The Striated Swallow.**

Numbers of these Swallows were to be seen daily below the pipe-line, particularly over a stream running through scrub and amongst rocks. I searched the rocks carefully, and found the remains of several old nests on the under-surface of some of the larger over-hanging rocks, but no sign of new work.

Zosterops palebrosa (Temm.). **The White-eye.**

Very common in pairs and small flocks. The flocks were occasionally mixed with tits, but were generally homogeneous.

Picus squamatus Vigors. **The Scaly-bellied Green Woodpecker.**

Numerous. A nest containnig young found May 5th. A pair of Mynahs appeared to be trying to enter the hole, and were vigorously repelled by one of the woodpeckers.

Picus vittatus Vieill. **The Himalayan Scaly-bellied Woodpecker.**

Occasionally seen.

Dryobates himalayensis (Jard. and Selby.). **The Himalayan Pied Woodpecker.**

Fairly numerous. One seen excavating a nesting-hole in a dead pine May 10. This species has a curious habit in the early mornings of rubbing its bill on a branch with the motion of a man sharpening a scythe. It seemed possible that this was its method of cleaning its bill, and was part of its morning toilet.

Dryobates auriceps (Vigors). **The Brown-fronted Pied Woodpecker.**

Quite the commonest Woodpecker at Ranikhet. Family parties were commonly seen from the end of May.

Leiopicus mahrattensis (Lath.). **The Yellow-fronted Pied Woodpecker.**

An adult was seen on an oak picking insects out of the bark and feeding a young bird clinging to the trunk below her on June 6.

Megalaima virens (Bodd.). **The Great Himalayan Barbet.**

Numerous and noisy.

Cuculus canorus (Linn.). **The Common Cuckoo.**

Numerous, particularly on open ground below 6,000 ft. Some individuals began to give the broken call (' Cuck-cuckoo') on May 23, but others continued in full call till I left on June 11. As in England the interval between the two notes of the Cuckoo's call varies slightly, but whereas the variation in England is generally only between a major third and a minor third, the variation at Ranikhet was between a minor third and a major second, and occasionally even less than that.

Cuculus optatus Gould. **The Himalayan Cuckoo.**

Calling very vigorously till the end of May. After the end of the month it was less frequently heard, and the call seemed weaker.

Cuculus micropterus Gould. **The Indian Cuckoo.**

Very numerous, calling throughout the period spent at Ranikhet. It generally begins to call before it is light, and frequently keeps up its call till after dark. The commonly accepted rendering of its call is '*Kaiphal pakka*', but the rendering given to it by British soldiers stationed in the hills, ' Lost my rifle ', is equally good.

Eudynamis scolopaceus (Linn.). **The Koel.**

Occasionally heard calling, generally below the military hospital.

Psittacula schisticeps (Hodgs.). **The Slaty-headed Parroquet.**

One seen in forest May 14. No other record.

Upupa epops Linn. **The Hoopoe.**

Numerous. Nests containing young found on May 7 and 9.

Micropus melba (Linn.). **The Alpine Swift.**

One seen May 10 about 6,200 ft. No other record.

Micropus affinis (Gray). **The Indian House-Swift.**

Three seen together May 23. No other record.

Otus spilocephalus (Blyth). **The Spotted Scops Owl.**

Heard at night from April 30 to June 10, but more commonly before the end of May than after.

Glaucidium brodiei (Burton). **The Collared Pigmy Owlet.**

One seen May 10. No other record.

Sarcogyps calvus (Scop.). **The Black Vulture.**

Fairly frequently seen.

Gyps himalayensis Hume. **The Himalayan Griffon.**

Occasionally seen, never near houses.

Gyps indicus (Scop.). **The Long-billed Vulture.**

Occasionally seen.

Pseudogyps bengalensis (Gmelin). **The Indian White-backed Vulture.**

Occasionally seen.

Neophron percnopterus (Linn.). **The Scavenger Vulture.**

Common.

Gypaëtus barbatus (Linn.). **The Lammergeyer.**

Very numerous over every type of country, feeding largely from offal in the station itself. A nest was found containing a young bird nearly ready to fly on a cliff below the pipe-line on May 23. The eyrie seemed to have been used for some years, and the ground near was littered thickly with fragments of bone.

Cerchneis tinnunculus Linn. **The Kestrel.**

Fairly numerous, particularly away from heavy forest. A pair of these birds had a nest on a rock above the pipe-line, where they were feeding a well-grown young bird on May 9 and 10. The old birds appeared to be tempting the young one to exert itself, as they always brought food to the end of the ledge on which the nest was situated farthest from the nest itself. The young bird ran along the ledge to its parents on their arrival, and retired again to the nest when they left. After May 10th, and up to the end of the first week in June, the young bird was being fed in trees and on other ledges of rock, not infrequently flying after its parents and calling shrilly for food.

Microhierax cœrulescens (Linn.). **The Red-legged Falconet.**

One seen several times about 6,200 ft. On June 2 he was bold enough to perch in the tree in the compound of the bungalow in which I was staying where a pair of Ashy Drongos had their nest. Both Drongos attacked him, and drove him off, pursuing him a good deal further than was their usual custom.

Aquila chrysaëtos (Linn.). **The Golden Eagle.**

One seen May 8. No other record.

Milvus migrans (Bodd.). **The Pariah Kite.**

Not very numerous.

Astur badius (Gmelin). **The Shikra.**

Occasionally seen on rough ground below 6,000 ft.

Sphenocercus sphenurus (Vigors). **The Kokla Green Pigeon.**

Fairly numerous in more open forest, generally in twos or threes.

Streptopelia orientalis (Lath.). **The Rufous Turtle-Dove.**

Numerous.

Streptopelia chinensis (Scop.). **The Spotted Dove.**

Very numerous.

Streptopelia senegalensis (Linn.). **The Little Brown Dove.**

One seen at Siuni on May 19. Occasionally seen near Ranikhet after that date.

Streptopelia decaocto (Frivalszky). **The Indian Ring-Dove.**

Fairly numerous. A pair had just completed a nest on Aug. 17 (when I revisited Ranikhet for two days), and the hen was on the nest and appeared to be in the act of laying when I left.

Gennæus hamiltoni (Griff.). **The White-crested Kalij.**

A pair seen on May 21, and on two or three subsequent occasions. They were always seen in pairs, and always in the more open type of forest.

Francolinus francolinus (Linn.). **The Black Partridge.**

One bird was always calling vigorously in the early morning, and sometimes in the evening, in thick, low scrub below the pipe-line, from May 28, onwards. On one occasion my dogs flushed a cock from the spot where he was always to be heard, but on no occasion did I see a hen.

Lobivanellus indicus (Boddært). **The Red-wattled Lapwing.**

A pair at Siuni on May 19 appeared to be breeding from their behaviour. No other record.

F. S. BRIGGS.

XX.—HOVERING FLIGHT OF BIRDS AND NO WIND.

The flight of birds has always been of great interest to me, but it is a behaviour involving great diversity and complexity of method. Each species of bird has its own distinctive methods, resulting in highly characteristic wing-movements, trajectories and velocities. Some birds are eminently superb gliders on motionless wing when they choose, as our hawks, eagles and buzzards. Others dash along with the directness of an arrow like the ducks and geese, fanning the air with tremendous persistence and energy.

I was much interested in the entertaining discussion of Major R. W. Hingston, 'Effect of wind on the flight of birds', *Journal of the Bombay Natural History Society,* Vol. xxxiii, No. 4, 1929, pp. 992-994. A comment, however, is needed here, bearing on his discussion, 'Effect of Wind on Hovering Flight'. While it may be true, as he states, that many birds as the kestrels, kingfishers and terns, take advantage of wind to perform their hovering activities, one of our American birds, the Ruby-throated Humming Bird quite refutes the concept that birds which poise need wind. Major Hingston's statement that 'No bird can employ its wings for the purpose of just raising itself vertically; there must always be some forward pushing element in the strokes', caught my attention especially, and our little Eastern ruby-throat at once came to mind. During the summer of 1930, I spent much time with these gay visitors in my garden, studying more critically their behaviour in flight. As a result of these observations, I feel that I can confirm my earlier opinions with some confidence.

I feel that we must recognize two types of hovering birds, those that may depend to a greater or less degree upon wind to help sustain their poise, and those that can hold themselves stationary in the air in a motionless poise of the body that must ever excite the utmost admiration. The great, distinctive, strictly New World humming bird family, indigenous to the Americas alone, exemplifies the latter behaviour. It may be a more or less specialized feature of the flight of these living gems,—it is probably more or less a family trait,—Since a flower-prober must often find it necessary to suspend itself in mid-air to delve into far-flung suspended blossoms. However this may be, I can speak alone for the diminutive ruby-throat of the eastern United States. I have often been within arm's length of its presence before my tiger lilies and Bee Balm (*Monarda didyma*), watching intently its marvellous grace as it literally hung its body in mid-air on invisible, whirring wings.

No wind is needed to perform its aërial evolutions before the flowers it visits. In truth a wind is disconcerting to it at times, tending to break the beautiful equilibrium of its motionless poise. On the calmest days its superb poise is seen, a perfect organic gem entering, receding, swerving, moving upward and downward in its systematic search from flower to flower. Let me state here that this marvellous flyer can elevate itself vertically as far as it chooses, drop slowly to lower levels with perfect ease as if floating in the atmosphere, even move backwards some distance away from a flower as it withdraws its bill and advances to another. All the while it moves its wings with such rapidity that only a glinting *whirr* is seen where its wings should be. How the tiny thing does all this, I cannot say, but in some manner the forward push of its wing-strokes is a component somehow neutralized even if it exists at all, and the bird remains stationary as long as it chooses as easily as some of the hover flies. I have seen them in their play with each other magnify all these capacities of movement, vertically, forwards, backwards. Furthermore, I saw one evening a flying behaviour on its part that I had never before witnessed. I had been inclined to feel that rapidity of wing-beat must be a fixed feature of its flight, but on this particular evening it zoomed over a high rose hedge, and holding its wings outstretched in a strangely quiescent position for a humming bird, glided down past me like a tiny emerald airplane and away, fast losing altitude as it went, perhaps intentionally, perhaps from necessity.

I doubt if we know much yet about the flight of many birds, notably among these the humming birds. I am inclined to believe they have an almost gyroscopic power of lifting and lowering their poising bodies with their swift-beating wings. Surely they can reverse the forward-pulling component of their strokes and push themselves smoothly backwards, or oscillate in the air like a living pendulum. It would be no simple matter to analyze the humming bird's wing movements, but I am inclined to believe the stroke and twist of the wings may be such as to do away at times with the usual forward component, allowing an exercise alone of the lifting, vertical component. Who knows what the gyratory twistings of these tiny wings may actually be at such times? To say the least in order to manipulate their play and strokes, their speed and positions with such nicety as to hold the body motionless in mid-air demands a marvellous control of the wings, a marvellous sensitivity of balancing forces and a most refined adjustment of the stroke, its power, speed, direction, to establish such a perfect equilibrium with the downward pulling forces of gravitation—and all in spite of wind.

WASHINGTON, D.C., H. A. ALLARD,
June, 1930. *U. S. Department of Agriculture.*

XXI.—PELICANS AND TURTLES.

On the afternoon of September 4, 1930, two Pelicans were found with Turtles hanging from their beaks in the Aquatic Birds' Pond in the Victoria Gardens. They were trying to swallow them. Each of the turtles weighed 9½ lbs. with a carapace 9½ inches long and about 8½ inches wide. Quite a mouthful even for a Pelican!

As soon as the keeper noticed this incident he drove the birds out of the pond and when they were on the lawn they immediately disgorged their victims. One of the Pelicans in the act got injuries to the pouch caused by the claws of the turtle with the result that there was a lacerated wound about 4 to 5 inches in length. The wound was dressed and treated with antiseptic and about 8 stitches were put in. The Pelican was in no way incapacitated from feeding. The wound healed up within a month, and the Pelican is now in the pond with others as happy as ever.

VICTORIA GARDENS, D. S. LAUD,
BOMBAY, *Supdt., Municipal Gardens.*
October 31, 1930.

XXII—LITTLE INDIAN GREBES OR DABCHICKS (*PODICEPS ALBIPENNIS*) MOBBING A SNAKE.

The other day, while out for a walk with my wife on the *bund* of a local tank, the following incident was observed which may be of interest.

A snake started to swim across the tank and was followed by a dabchick. The snake was very uneasy as the dabchick was obviously trying to attack it, and several times turned and went for the bird who, however, easily evaded it. This fracas attracted other dabchicks and the snake made for a small island; the dabchicks, six in all, following, turned him off the island and he again had to swim for it, harrassed by the birds whom he frequently turned and tried to attack. The dabchicks, however, stuck to him and saw him off the tank. The snake was obviously not a water-snake or he would have dived and avoided these attacks. We were not near enough to identify the snake but I fancy it must have been a Dhaman (*Zamenis mucosus*) as these are very common about the tanks at Hyderabad. The dabchicks cannot have been nesting, as this tank is dry in the hot weather and has only partially filled in since the monsoon started, so that cannot account for the aggressiveness of these birds.

SECUNDERABAD,
June 14, 1930.

C. C. HICKIE,
Lt.-Col.,
3rd/16th Rajputana Rifles.

[The behaviour of the dabchicks in the water is not infrequently witnessed among birds on land when a number of different birds combine to harass and mob a snake which they have discovered. They obviously sense the presence of a common enemy. Strangely enough, birds do not usually display fear of snakes. We have seen a hen calmly feeding on grain in a python's cage. She took not the slightest notice of the huge snake coiled a few feet away from her. A crow, on the other hand—and the crow is the most intelligent of birds—showed the acutest realization of the danger. Much has been written and believed about the hypnotic influence the snake is supposed to wield over its intended prey. It is mostly curiosity which impels an animal to remain in the presence of its attacker. It watches the slow approach of the aggressor, the slow movement of the head or the quivering of the tail. The same influence may be exerted by the movement of the human hand. EDS.]

XXIII.—CANNIBALISM IN THE INDIAN COBRA

Last November we got two vigorous, full-sized cobras (*Naia tripudians*) fresh from the jungle, with their fangs and poison glands intact, and kept them in one of our snake cages. Cobras usually remain nervous in captivity, and it was necessary, therefore, to provide them with some dried-up straw, so that they might hide themselves from unwelcome molestations.

One morning, over a fortnight after the cobras were brought to us, an alarm broke out that one of them was missing. There was no possible way of escape, the cage being as reliable as ever. On examination we found the girth of the remaining snake a little bigger than usual, and it looked probable that the fellow was guilty of cannibalism. We were right too! About twelve or fifteen days after, the suspect defecated the remains of its unhappy comrade, and there was no mistaking them.

I do not know, whether the cannibalistic tendency of the cobra has been mentioned before, but even after last year's episode I have seen cases proving it in captivity at least. Four days back I saw one of our encaged cobras gripping a harmless snake, the Red Earth Boa (*Eryx conicus*), in its mouth. The latter in its turn coiled tightly round the aggressor's head and struggled violently. When our laboratory assistant separated them from each other, the cobra got so excited that it caught hold of the head of another cobra, and we had to separate them also. In the night, however, the *Eryx* served to gratify the cobra's appetite—a loss, which we felt a great deal, as this was our only living specimen of the Red Earth Boa. I do not suggest that cobras eat one another normally in nature; that may or may not be the case. But I have certainly seen examples of cannibalism in this species in the artificial conditions of captivity.

St. John's College,
Agra,
August 30, 1930.

BENI CHARAN MAHENDRA,
Lecturer in Zoology.

[Cannibalism is not an infrequent trait among snakes. The ophiophagus or snake-eating habits of the Hamadryads and the Kraits is well known. In Vol. xvi, p. 395 of the *Journal,* Mr. W. S. Millard, then Hon. Secretary of the Society, gives several instances, among them, that of a black and a yellow cobra. Both cobras tried to make a meal of the same frog with the result that the black cobra swallowed both the frog and the yellow cobra. Swallower and swallowed were about the same size.

Various instances of cannibalism among snakes are also recorded by Col. Wall. (*Journ. B.N.H.S.,* Vol. xxv, p. 524.) Our most classic instance is however that of two Pythons—a large and a small one, who shared a cage in the Society's museum.

They commenced a meal one at the head and the other at the tail of a black partridge. The smaller snake, while feeding, was partly coiled in the folds of a red blanket. The big python went steadily on. The presence of a rival did not disturb him. He swallowed the partridge and his brother python and the red blanket! Eds.]

XXIV.—UNUSUAL SIZE ATTAINED BY THE COMMON KRAIT (*BUNGARUS CÆRULEUS*)

With regard to our recent correspondence on the subject of kraits, you may be interested to hear that I had one brought to my office yesterday which was 5 ft. 8½ inches long. It was carefully measured by myself, assisted by Major T. E. B. Beatty, R. A. M. C. (S. M. O. here) and Khan Bahadur Mohamed Umar (Vice-President of the Cantonment Board). We tried to have it skinned; it was already a bit smelly and I did not want to gas you again! But unfortunately our local skinner, who is quite good at Mugger, was completely baffled by the thin skin of the krait. There is not the slightest doubt that the snake was of the same species as the one I sent you before. It had the same markings and the same enlarged row of scales down the centre of the back and the same formation in the scales of the lower lip, leaving no shadow of doubt as regards its identity.

Cantonment Authority's Office,
Fyzabad,
July 26, 1930.

F. J. RIMELL,
Captain,
3/7th Rajputana
Regiment.

[This is certainly the largest common krait we have ever heard of. Several instances of kraits well over 4 ft. have been recorded, Capt. Rimell sent us one measuring 4 ft. 7½″ a few weeks before he wrote us about the present species. It was a good example of vigorous growth but easily beaten by his present record which is well-nigh 6 ft. in length. EDS.]

XXV.—AN UNUSUALLY LARGE SHAW'S RAT SNAKE (*ZAMENIS FASCIOLATUS*).

A snake was seen in the first week of January this year on the steps of the shop of Messrs Cursetjee and Sons, Camp, Ahmednagar, by Mr. Walsh, acting Garrison Engineer, about 7-30 p.m. He hit it with a stone when the snake at once erected itself and flattened out its fore-body, apparently looking like the hood of a cobra. The snake was killed with a stick afterwards and it bled profusely. It was sent to the Indian Military Hospital, Ahmednagar, where it was bottled and seen by me the following week. The snake looked superficially very much like a cobra. It was brownish-black in colour but it had not got the third supralabial shield touching the eye and the nasal shield, nor had it the cuneate shield between the fourth and fifth infralabials. It had no fangs and it had a distinct row of small teeth on the side of the upper maxilla.

The snake was identified as *Zamenis fasciolatus* or Shaw's Rat-Snake. It is rather an unusually big specimen in length and girth. Col. Wall mentions in his book *Snakes of Ceylon* that the largest one he had examined was 4 ft. 2½ inches whilst Mr. D'Abreu had acquired one specimen at Nagpur which measured 4 ft. 5 inches. This specimen at Ahmednagar measured 4 ft. 8 inches and its maximum girth was 5 inches. Boulenger, however, mentions that *Zamenis fasciolatus* may grow to 8 ft. 5 inches. (*Fauna of British India and Dependencies*).

Wall states its subcaudals to be 73-92. The subcaudals in this specimen were only 61 and the tail does not appear shortened or cut off. The specimen was sent to the Curator of the Bombay Natural History Society's Museum.

It may interest your readers to know that the word 'Dhāman' or 'Dhāmin' as applied to rat-snakes is a Hindi word and is probably derived from the Sanskrit word 'Dāman' (the pronounciation of the 'd' is dental and not lingual, which means 'a rope'. The word Dhāman is also a Sanskrit word but it means a 'dwelling or an abode'. The dental 'd' of 'Dāman' is apparently colloquially changed into dental 'dh' as the proper Sanskrit word Dhaman does not mean a rope. The ordinary rat-snake (*Zamenis mucosus*), which is a very common snake, looks very much like a rope. When irritated it vibrates its tail violently, the tail looking like a wriggling rope.

AHMEDNAGAR,
October 7, 1930.

K. G. GHARPUREY,
Lieut.-Col., I.M.S.,
Civil Surgeon, Ahmednagar.

XXVI.—SNAKES OF NASIK.

I was Civil Surgeon at Nasik for about ten months from January 25, 1929, to November 20, 1929. As it appeared from the general climatic conditions and situation of Nasik that it should be one of the 'snakey' places in the Deccan, I put up a notice at the Royal Western India Golf Club, Nasik, and also at the Indian Clubs in the town and the Municipal Office that any snakes killed should be sent to me for identification. The Medical Officers in charge of dispensaries in the District were also similarly instructed. The response was fairly good as during this period 101 snakes were brought to or seen by me. They were mostly identified by me and some were identified by the Bombay Natural History Society. The snakes were from Nasik, Nasik Road (Distillery compound, Central prison, etc.), and from some few places in the district.

They were the following :—

Naia tripudians.—20 in number. The majority of these were seen and killed during the day, showing that the Cobra is as a rule diurnal in its habits. One live Cobra was brought with its mouth sewed up. That some snake catchers do this is evident from the real snake story published in the *Illustrated Times of India Weekly* of July 20, 1930. Stitches on one side of the mouth were removed and it was found that the fang on that side was intact.

The longest cobra was 5′ 3″.

Baby Cobras were seen on July 27, 1929, July 29, 1929 and July 30, 1929 in the Golf Club compound and two other bungalows near it on the same side of the road, indicating they were from the same breed. These hatchlings were 8½″ long. This indicates that these cobras were hatched from one brood in the last week of July.

Lycodon aulicus.—11. Nearly all of these were seen and killed at night, showing it is usually a nocturnal snake. One female, killed on March 3, 1929, had 8 eggs with medium development.

Zamenis mucosus.—13. This is essentially a diurnal snake, as all were seen and killed during the day. The longest was 7′ 8″.

Dipsadomorphous trigonatus.—11 specimens. This snake was seen during the day but usually prefers to be out at night, as whenever exact information about those who were sent to me was available, they were all killed at night.

Macropisthodon plumbicolor.—9. This green snake is a common snake about the Golf Links. A small baby one 8″ long, was seen on July 28, 1929. This was probably hatched during the last week in July.

Coluber helena.—5.

Tropidonotus stolatus.—2.

Tropidonotus piscator.—2.

Zamenis gracilis.—1.

Oligodon subgriseus.—2.

Oligodon arnensis.—3.

Polydontophis subpunctatus.—1.

Bungarus candidus.—The Common Krait is essentially a night snake, as all were seen at night.

Callophis trimaculatus.—2 specimens of this small Coral snake were seen.

Daboia russelli.—5. Longest was 4′ 6″.

Echis carinata.—3. All these were seen bottled in Barnes' School, Deolali.

Python molurus.—1. This was sent alive from Peint and measured 8 feet.

Eryx conicus.—4.

Typhlops brahminus.—1. This was also seen bottled in Barnes' School, Deolali.

So out of 101 snakes 32 were highly poisonous (Cobras, Kraits, Russell's Vipers and Echis).

AHMEDNAGAR, K. G. GHARPUREY,
August 5, 1930. *Lt.-Col., I.M.S.*

XXVII.—OCCURRENCE OF *CHARASIA DORSALIS* OUTSIDE THE MYSORE PLATEAU.

In part 2, Vol. xxxiii, p. 454, H. Jouguet states that '*Charasia dorsalis* does not seem to be distributed outside the Mysore Plateau'. I may state that specimens of this lizard were taken by me in a ruined temple near the Travellers' Bungalow at Gingee in the S. Arcot District of this (Madras) Presidency in the year 1920.

S. G. MANAVALA RAMANUJAN.

PRESIDENCY COLLEGE,
MADRAS,
August 15, 1930.

XXVIII.—SOME MEASUREMENTS OF THE ESTUARY CROCODILE (*CROCODILUS POROSUS*) FROM SARAWAK.

In the last number of the *Journal of the Bombay Natural History Society* (Vol. XXXIV, p. 584) attention is drawn to the lack of measurements of the Estuarine Crocodile and the following will therefore be of interest :—

Sex	Total Length	Head Length	Tail Length	Total Weight	Brain Weight
1 ...	1′ 4″ ...	2·75″ ...	3·5″ ...	5 ozs.	
2 ♀ ...	1′ 9″ ...	3·25″ ...	10″ ...	10 ,,	
3 ♂ ...	1′ 9″ ...	3·5″ ...	10·5″ ...	9 ,,	
4 ♀ ...	1′ 10″ ...	3·4″ ...	11·25″ ...	11 ,,	
5 ♂ ...	1′ 10·5″ ...	3·5″ ...	12″ ...	11 ,,	18 grains.
6 ♂ ...	2′ 1·5″ ...	4″ ...	1′ 0·5″ ...	1 lb.	
7 ...	2′ 3″ ...	4″ ...	1′ 3″ ...	1 ,, 5 ,,	
8 ♀ ...	2′ 2.5″ ...	4″ ...	1′ 2·5″ ...	1 ,, 3 ,,	

Sex	Total Length	Head Length	Tail Length	Total Weight	Brain Weight
9 ♂	2′ 5″	4·25″	1′ 2·25″	1 ,, 9 ,,	
10 ♂	2′ 5″	4·5″	1′ 3″	1 ,, 10 ,,	
...	2′ 11″	5·25″	1′ 6″	3 ,, 2 ,,	
11 ♂	2′ 11·5″	5·25″	1′ 3″	3 ,, 2 ,,	
12 ♂	3′	5·25″	1′ 6·25″	3 ,, 7 ,,	
13 ♀	3′ 2·5″	5·25″	1′ 7″	3 ,, 4 ,,	55 ,,
14 ♂	3′	5·5″	1′ 6″	3 ,, 11 ,,	
15 ♀	3′ 2·75″	6″	1′ 8″	4 ,, 8 ,,	
16 ♀	3′ 4″	5·75″	1′ 7·25″	5 ,,	
17 ♀	3′ 2·5″	...	1′ 7·5″	4 ,, 7 ,,	
18	3′ 3″	5·75″	1′ 7·25″	4 ,, 8 ,,	
19	3′ 9·5″	...	1′ 9·75″	7 ,, 4 ,,	
20 ♂	3′ 7·25″	6″	1′ 8·5″	5 ,, 2 ,,	62 ,,
21 ♂	4′	6·75″	2′ 0·5″	9 ,,	72 ,,
22 ♂	4′ 11″	8″	2′ 4″	16 ,, 8 ,,	
23 ♂	5′	9·5″	2′ 7″	21 ,, 8 ,,	
24 ♀	6′ 4″	...	3′ 0·5″	38 ,, 8 ,,	140 ,,
25 ♀	6′ 6·5′	10″	3′ 2″	49 ,, 8 ,,	
26 ♂	4′ 9·5″	10·5″	1′ 8″	36 ,,	124·5 ,,
27 ♀	7′	12″	3′ 5″	64 ,,	174 ,,
28 ♂	7′ 3″	12″	3′ 5·75″	57 ,,	
29 ♀	7′ 7″	12″	4′ 1″	82 ,,	
30 ♂	7′ 3″	12″	3′ 6·5″	...	
31 ♂	7′ 5″	12″	3′ 7·5″	78 ,,	
32 ♀	7′ 9″	13·5″	3′ 8″	67 ,,	216 ,,
33 ♀	7′ 10″	13″	3′ 1·5″	78 ,,	
34	8′ 2″	14″	...	...	
35 ♀	8′ 2″	14″	4′	94 ,,	
36 ♀	8′ 3″	15·25″	4′ 1″	91 ,, 8 oz.	278 ,,
37 ♀	9′	15·5″	4′ 7″	140 ,,	

Sex	Total Length	Head Length	Tail Length	Total Weight	Brain Weight
38 ♀	9′ 8″	16·5″	4′ 9″	183 lb.	
39	11′ 7″	19·5″	...	...	
40	12′	20″	5 11″	300 lb.	
41	16′ 6″	25″	...	...	

No. 26 had part of tail missing.
,, 36 had about 60 eggs.
Nos. 5, 6, 8 & 19 had a number of rounded pebbles in stomach.
No. 20 had remains of a small crab in stomach.
,, 11 had stomach crammed with vegetable matter and fruits.

The Crocodiles came from the tidal portions of the Sadong, Samarahan, Kuching and Lundu Rivers in Western Sarawak; measurements were made on fresh specimens, Head length from tip of snout to posterior border of Parietal, Tail length from tip to centre of outer opening of cloaca.

From the above measurements it may be deduced that the Estuarine Crocodile is, irrespective of sex, usually a little more than seven times as long as its own head; assuming therefore that this growth rate applies to even the largest specimens, a skull thirty-nine inches long would belong to a twenty-three foot beast and thirty foot 'Crocs'—like thirty foot Pythons—have still to be measured, at any rate in these parts.

Twenty eight inches is the longest Museum skull here, indicating a total length of only about seventeen feet.

SARAWAK MUSEUM,
KACHING SARAWAK,
October 1, 1930.

E. BANKS,
Curator.

XXIX.—THE WAYS OF FISHING *SHIKARIS.*

Though shikaris vary in character and personality, they all have one thing in common, namely, the desire to get all they can out of you. They are shameless beggars and will ask for clothes, food, money, etc., in the most bare-faced way. Apart from this universal failing, many of them are very good company and keen sportsmen.

A great deal depends on one's shikari. If you take a dislike to your shikari he will ruin all your pleasure. Everything he does will annoy you, he will get on your nerves, and his very presence will irritate you. It is much better to have an inefficient shikari whom you like than an efficient one whom you dislike.

I remember, Aziza, at Koolgam in Kashmir; he was a cute boy and very capable, but he was not a sportsman and took little interest in what you were doing. Whenever I got into a fish, Aziza would be sure to be looking in the opposite direction. This used to make me furious, especially when, through looking round to see what he was doing, I lost a good fish. He also annoyed me by constantly badgering me to change my flies. I think his object in this was the theft of a few flies, because he would prepare a cast for me while I was fishing, and I foolishly let him have my fly box to select from.

He was by way of showing me the best places in the river, but when at length I got fed up with him and took matters into my own hands, and explored for myself, I found he had been keeping the best places hidden from me. I have found this with other Kashmir shikaris, and it is always best to explore the whole of the river oneself.

Shikaris are not a particularly clean class, especially as regards their clothes. A man I had in the United Provinces always had such a strong smell of some very unpleasant kind of smoke exuding from his clothes that I could not bear him near me. He would come to me during the week and ask what river I proposed fishing on the coming Sunday. If the river happened to be some distance away he would say it was no use going so far unless I first made sure that there were fish about. This of course meant his railway fare there and back, and I know he never went near the place. Should I select a place near at hand then eight annas would be required for *ata* with which to ground-bait it the day before. These were his methods of making a little beyond his pay.

Samdhu, in all other respects an excellent Kashmir shikari, had an annoying habit whenever one caught a fish over the average, of saying 'that's a *baksheesh wala*'.

I believe that when a son is born to a ruling prince, it is the custom for that prince to distribute alms in token of his good fortune. I conclude the line of thought adopted by shikaris runs in some such channel. Otherwise I can see no reason why your shikari should be rewarded because *you* happen to catch a fish above the average. However, any excuse seems good enough for demanding '*baksheesh*'.

I once had a shikari who was so frightened of the river that nothing would make him go into the water beyond his ankles. Very different to this man was one I had on the Mal river in Poonch. He would swim across the river with my tackle box and rod on his head.

Ahmadu was a born poacher and tried to make you fish for trout with frogs, however he was frightfully keen, and you can forgive a lot when a man is really keen.

There are hardly any shikaris in India who know how to use a landing net properly, though quite a fair number of them know how to tie on a fly.

Most shikaris size up their employers pretty quickly and soon know those they can take advantage of and those they cannot.

One rather boring trait that most shikaris have is that of recounting to you what *bahadurs* other *sahibs* were who have employed them. Smith sahib caught a record fish, Jones sahib had a beautiful rod, Robinson sahib was a wonderful fisherman and caught more than anyone else, Jenkins sahib was obviously rich, and so on, until you get the impression that the only person devoid of any virtue is yourself.

After listening to some shikaris I have had a very humble opinion of myself. I have felt that unless I gave my shikari a tip, equivalent at least to a month's pay, I should be considered very mean, because (according to the shikari) Thompson sahib had been so pleased with him that he had showered money and presents on him. How I hated the very sound of Thompson sahib's name!

A shikari loves to tell you that he taught such-an-such a sahib all he knows about fishing, and the most ignorant of them are ready to give you advice.

Shikaris vary tremendously, not only in their knowledge of fishing but in their capabilities. I have had some men who would shin up a tree in no time and recover my fly from some inaccessible branch, and who would leap from boulder to boulder in the midst of rapids, in order to release my hook from a rock or sunken piece of wood. Some men will dive to the bottom of the river to recover a spoon that has got caught in something. But I have had others who were quite incapable of climbing a tree and who were frightened of the water.

One of the best and most charming shikaris I ever had was old Rahima. Like all shikaris he had his failings. He had a way of telling you how kind other sahibs had been to him in giving him clothes, and money to buy a new shikara, the cost of a licence, etc., etc., and he left no doubt in your mind that he expected similar kindness from you. He informed you that should you be so fortunate as to catch the first mahseer of the season, you would be expected to stand all the shikaris in his village a dinner, such was the custom, he said.

Should the day happen to be a cold one, he would shiver and mumble about his lack of warm clothes, yet in spite of all the 'kindness' he received I never saw him wear anything but his dirty old *choga*.

In spite of his mania for extracting money, etc., from you one could not help loving him. He had the most charming manners and an endless fund of conversation. He could tell you of many interesting fishing experiences, and not a little scandal concerning various sahibs who had been in Kashmir during the last fifty years. He would while away hour after hour telling you these things as well as the folk-lore of Kashmir, and this, in spite of the fact that his knowledge of English was *nil* and his Urdu was very limited.

I can look back on many pleasant hours spent in his company and, like most of the shikaris in Sopore to-day, I have to thank Rahima for much of the knowledge I have acquired in the art of angling.

He was so thoroughly efficient that he gave one a feeling of great confidence. One knew it was impossible to have a better shikari, and if you did lose a fish it would be through no fault of his. He never forgot to test your line or traces before you commenced to fish, and he always hung your line up to dry at the end of the day. To see the quiet way in which he would lift a 40-lb. Mahseer out of the water was an education. He never got in a panic and always knew what to do and when to do it, and more important still, never failed to do it.

On one occasion when I had a big mahseer on, my reel jammed. As quick as lightning Rahima cut my line and joined it to the line on my spare rod, and all was well.

He always knew the best spots to fish in, and the necessary weight and length of line were calculated to a nicety. A chef at Claridge's could not have been more particular in the matter of weights and measures than Rahima was.

Although he was generally to be seen curled up at the end of his *shikara,* from which precarious perch he issued his orders with as much dignity and force as the captain of an Atlantic Liner, he was as active as most men of half his age. He would think nothing of towing his *shikara* twenty or thirty miles in the day, and I have seen him wade through deep rivers with one of my servants on his shoulders.

He had more pluck than the average Kashmiri and did not lose his head in a storm as most of the boatmen did. On one occasion, when there was a strong breeze blowing up-stream, which knocked up quite a 'sea', I rigged up a sail in my *shikara.* None of the boatmen would come out with me, but old Rahima did not fail me though he regailed me all the time with an account of two foolhardy young sahibs, whose graves I could see at Baramulla, who were drowned doing this self-same thing.

If I was out by myself in my *shikara* and a storm came on, Rahima would always turn up in his little *shikara* to see if I required assistance.

Like all Kashmiris, he had a wonderful memory. He could tell me the various years I had been in Kashmir and where I had come from each time. He could tell me, years afterwards, how much I had paid for my rods, etc. He remembered the names of hundreds of Englishmen who had employed him, and could tell me the names of their regiments and stations. In fact he was a living Army List. He had his favourite *sahibs* and was very faithful to them.

I suppose there must be a man like Hardy in Heaven, who manufactures perfect fishing rods for elect anglers, and I expect Rahima is now catching enormous mahseer in realms where there is no night. He died a few years ago. Without angling there could be no Heaven for Rahima.

I have fished with all sorts of shikaris in different parts of India, but never have I enjoyed such good company as I did with Rahima nor have I found a keener or better man at his job.

If, when I join the great majority, I am found worthy of reward, I feel sure that reward will take the form of a good river with Rahima for my shikari.

C/O GRINDLAY & CO., A. E. MAHON,
BOMBAY, *Colonel.*
June, 1930.

XXX.—A LEAF-MINING MOTH.

On a Sunday morning, about three weeks ago, while in a garden two miles outside Bhuj, my attention was drawn to a tree—*Pongamia glabra*—of which there were many there.

Pongamia is known locally by the name of *Karanj*. It is an evergreen, pretty, shady, tree as a rule. The leaves of these particular trees in the garden, were simply studded over with round or irregularly round, white spots, which on closer examination proved to be blisters of the epidermis. They varied from one-eighth to half or five-eighth inch in diameter and contained imprisoned air, as on pricking with a pin they collapsed and became flat and wrinkled, the air in them having escaped. With the flattening of the blisters, I could see a small oval seed-like protuberance on a part of the leaf surface, not necessarily central. It led me to cut open the blister and separate the thin epidermis, under which I noticed the raw chlorophyll surface like the base of an indolent ulcer in men and animals. On the green surface, in almost every case, I saw a tiny, minute worm, like a maggot, wriggling actively, or moving like a caterpillar. Naturally it led me to conclude that it was the larva of some insect. I opened nearly 100 blisters and in almost every case, I found a larva. I never saw more than one larva in any of the blisters, of which there were two, three, four to six on the surface of each leaf, which looked as if it was stricken with smallpox. Unfortunately I had no magnifying lens or any other means to examine the larvæ more closely. I therefore contented myself with taking with me a dozen or so of the infected leaves and put them all under a bell-jar to watch further developments. Unfortunately I had to go out of the station for a week, leaving the leaves under a glass. On my return I pricked some of the blisters and found to my surprise that while the larvæ in a few instances had grown much bigger, in others they had formed a cocoon round themselves and become fixed to the chlorophyll surface . One could see the white glossy slik of the cocoon even with the naked eye. I mounted on glass slides a few of the larvæ for microscopic examination and study of their anatomy and left the others for further and fuller development. Two or three days after, I started re-examining the blisters and to my delight and expectation I found the crysalis stage completed in some, and about to complete in others. I lifted them and put them under the microscope. Oh, the wonderful sight they presented ! One could see the antennæ, the maxillæ, the mouth, gullet, thorax, the three pairs of legs and nine abdominal segments, ending in semilunar last section; the moniliform antennæ contained nearly forty or more joints one on either side, the large black paired eyes and, lastly the two pairs of wings—all in brown colour. Two days after, I examined the bell-jar from outside and noticed six insects, fully developed, very active and hopping on their legs or flying about on their wings, which under the microscope showed to be stained in black at intervals. They looked very picturesque. Like the wings of the moths and butterflies, they left a coating of their glossy and silky material on the fingers or on the glass slide. All the specimens of the full-grown individuals which I examined on September 9, 1930, were alike in colour and every other detail—all brown. To-day, on September 10, I saw a few individuals, which were as active as those seen before but they were black instead of brown. I had taken good care to see that no outside insects could get inside the bell-jar. I was therefore not a little surprised to see these fresh arrivals in black garments! They were very active and were frisking all over the inside of the glass. It was difficult to catch them alive for fear of their flying away and escaping. I therefore introduced a little chloroform in the bell-jar and within a few minutes two of them dropped unconscious on the paper at the bottom of the bell-jar. I picked them up on a platinum loop dipped in cedar oil, mounted them on a slide and examined them under the microscope. The bodies were one mass of black. One could see the antennæ which were moniliform, but not so long as those of the brown individuals. In one case they were branched at three or four joints. The branches were also moniliform. This black variety was smaller than its brown fellows and had two blisters at the anal end. Probably they were females as opposed to the brown ones which were males or it may be *vice versa.*

I am not an entomologist and am, therefore, not able to identify them and to know their properties, favourable or otherwise to man. To their host they are distinctly harmful. One could imagine the evil effect of having thousands of pustules or scabs (with an animal parasite in each) on the person of a human being, child or adult. They destroyed the chlorophyll. With the destruction of chlorophyll, the growth of the tree and its economic value are bound to suffer. I have no doubt the forest experts have noticed this pest, identified it and have found means for its destruction.

Pongamia is a very useful and pretty tree. Rev. Nairne describes it as the commonest and the handsomest tree in India. Economically it is an important tree as its seeds give a very useful oil.

The parasite is, I think, a species of moth and has a selective property. It attacks *Pongamia* alone in preference to others as far as I could see. Hence the neighbourhood of this otherwise handsome and pretty tree— is not to be desired near human dwellings. For, even if it does not give rise to any disease—it is no doubt a nuisance to have an army of moths hovering about your face, specially on the lighted dinner or writing table.

KUTCH,
June, 1930.

G. R. TAMBE,
M.A., B.SC., L.M. & S.,
Chief Medical Officer.

[Dr. Tambe forwarded specimens of the larvæ, pupæ and imagoes to the Society. They were submitted to Dr. Hem Singh Pruthi, Zoological Survey of India but they were in too damaged a condition to be of any use in ascribing them to any particular genus. The larvæ of several Tineid Moths mine leaves. These leaf-miners are amongst the smallest of plant-eating animals, most of them find both substance and shelter within the confines of a single leaf, often within a small portion of a leaf, between its upper and its nether epidermis. Their food is the thin stratum of green tissue outspread in a seam between two worthless adjacent strata and the insects get it and dig it out for their food. This is why they are called leaf-miners. They are all larvæ of various insects, of Moths, Fleas, Beetles and Sandflies. Some of them make winding galleries on the leaf. Others excavate broader chambers covered with silk in which they transform into a pupa and finally emerge as fully-developed insects. EDS.]

XXXI.—SPECIFIC IDENTITY OF THE BUTTERFLIES (*TERIAS VENATA AND T. LÆTA*).

In Vol. xxiii, Part 3 of the *Journal,* I published a note giving reasons for my belief that the two butterflies above mentioned were seasonal variations of a single species. Mr. Bell agreed with me as to the probability but the evidence was not conclusive. I am now in a position to state that I have definitely proved my belief to be correct.

Last year I was at home on leave, therefore unable to make any further breeding experiments. This year I took up the matter again. I had observed that, in this district, *venata,* common from the end of June onwards, began to be replaced by *læta* about the middle of September and by the end of that month had disappeared, while *læta* had become abundant. In August, therefore, I planted some specimens of the local food-plant, *Cassia pumila,* in pots. Over the plants I erected cages of mosquito-netting and in these, on August 28, I placed half-a-dozen captured females of *venata,* supplying them with sugar and water, and kept the cages in the sunshine.

Fortune was on my side for, in the next two days, two of the ladies obliged by depositing eggs, about twenty in number. I then had to be absent from home for a week but, on my return, found about a dozen larvæ, three or four days old, on the plants.

A day later there was a tragedy. Ants discovered the pots and, in one night, destroyed all the larvæ except three! Fortunately these three survived to attain the pupal stage, one three days later than the other two. On September 19 from two of these pupæ emerged two male butterflies but, to my great disappointment, undoubtedly *venata,* although one had markings on the underside approximating to *læta.*

A single hope remained and by him I was justified for, on September 23, my last pupa produced what I considered an indubitable male *læta*! He was not a very typical specimen however, in, that, while the apex of the fore-wing was correctly acuminate, the ground colour of the hind-wing underside was a pure yellow instead of the more usual yellowish-buff or buff-yellow; its markings too, though typical *læta* in form, were dusky blackish instead of reddish. This is a variety which I do not find mentioned by Bingham in the *Fauna* but it occurs regularly, though not numerous, in this district in September. It sometimes has a tiny black patch on tornus of fore-wing. In colouration it is distinctly intermediate between typical *læta* and *venata.* The shape of the fore-wing also, though nearer to *læta,* has a slight tendency to convexity of the outer margin. If, however, it had to be assigned to one form or the other, I should have no hesitation in labelling it *læta.*

This single specimen of an intermediate type may not be considered to afford adequate proof of my case. But this was not the end of my experiment. When I found that my hopes of a successful issue were dependent on a single pupa, I determined to try again. I had left it rather late, *læta* was already abundant; of *venata* males, I only came across three; but at last, when almost despairing, I captured, on September 22, a single rather elderly *venata* female. Her figure however indicated that she had not disposed of all her eggs, so I was not without hope and gave her a trial. To my joy, the next two days she laid quite a number of eggs.

To cut the story short, the survivors of the resultant larvæ and pupæ produced, between October 11 and 14, eleven butterflies. But once again those fiends, the black ants, interfered to try and upset my plans ! I was now away from home in the district and had not made the position of my breeding cages ant-proof. The result was that the ants attacked and cut to pieces, or badly damaged, five of the eleven butterflies when freshly emerged and helpless ! However, some were unharmed and I found myself in the end with seven specimens fit for study.

These seven were divided as follows :—

(*a*) 2 *venata*.
(*b*) 2 *læta,* hind-wing underside yellow.
(*c*) 2 *læta,* ,, ,, yellowish-buff.
(*d*) 1 *læta,* ,, ,, creamy-buff.

Of these, the last three correspond to Bingham's wet-season form except that the irroration on the hind-wing underside is composed of blackish not rust-coloured scales. On the wing in September, (*d*) is the commonest form, but the rust colour is increasingly in evidence in October. Of the two *venata,* both resembled the early females of June in the contraction of the black border of the hind-wing upperside, but one was of the typical dusky type while the other approximated to *læta* form (*b*). It is also noticeable that the shape of the fore-wing in (*b*) is nearer to *venata* than in (*c*) and (*d*).

The differences in these insects of a single brood, all bred under the same conditions, present an interesting problem. That there would have been any specimens at all of *venata* had the larvæ and pupæ lived entirely out of doors under natural conditions I do not believe. Tentatively I put forward the suggestion that light may be one of the factors in the seasonal change of form. The months of July and August are ordinarily much more cloudy than September : after the first day or two, larvæ had no sunshine at all.

However this may be, the specific identity of *venata* and *læta* is definitely proved : *læta* is a seasonal variation of *venata,* with occasional intermediate forms. Or should it be the other way round? I do not know which name is entitled to claim priority.

BHAVNAGAR, A. H. E. MOSSE,
October, 1930. *Lt.-Colonel, I.A.*

XXXII.—THE GRASSHOPPER (*ISOPERA PEDUNCULATA*) AS A MIMIC OF THE BLACK ANT (*C. COMPRESSUS*).

If Mr. McAtee will be so good as to sit for ten seconds at the exit of a termite's nest when swarming and count the number of termites destroyed by birds, he will find that the number probably approaches 100. If he will then sit for ten minutes outside an Indian Black ant's nest in the same swarming condition and take the trouble to make a similar calculation of workers he will certainly find that the number is *nil.*

That is the difficult way of learning about nature, but it will teach him a far truer and deeper lesson than will all the literature in all the world.

He will learn at least the strict truth of my assertion that *worker ants of the species Camponotus compressus are rarely taken by birds.*

October, 1930. R. W. G. HINGSTON.

(See Maj. Hingston's Note on the above subject, Vol. xxxiv, No. 1, p. 170 and Mr. McAtee's Note, Vol. xxxiv, p. 591).

XXXIII.—A LIVE BEETLE IN THE EXTERNAL AUDITORY MEATUS OF THE HUMAN EAR.

On June 20, 1930, a strong well-built man was brought to the Civil Hospital by his friends, who stated that an insect had got into his left ear. The patient was shouting and writhing with pain; he was quite unable to keep still for a moment and was administering vigorous slaps with his hand to the side of his face in a vain attempt to relieve his pain. There was a little fresh blood about the orifice of the ear, but it was obviously impossible to make any further examination without the aid of an anæsthetic. Chloroform was therefore administered and a careful examination showed the external auditory meatus to be occupied by a shiny green body, which I thought might possibly prove to be the ordinary blister-fly.

A small piece of cotton wool was saturated with chloroform and inserted over the posterior end of the insect and held in the meatus for two or three minutes with the idea of killing the intruder before attempting its extraction. This measure was indicated because of the presence of blood at the orifice of the ear, which I thought was most likely to be due to the insect having attached itself to the delicate drum of the ear.

Syringing was ineffectual as the insect was tightly-wedged in the deep part of the ear. It was, however, easily removed by gentle traction with a pair of forceps. The ear-drum was then carefully examined and on its posterior segment were seen two small superficial punctures of its surface, which presumably represented the damage inflicted by the jaws of the beetle.

The beetle was removed intact, it was green in colour and measured three-fourths of an inch long and five-eighth inch in its widest part; on its green wings were numerous white spots.

Nasik, A.G. TRESIDDER,
June, 1930. C.I.E., *Lt.-Col., I.M.S.,*
Civil Surgeon.

[The beetle submitted to us for identification is *Protactia alboguttata,* Family *Melolonthidæ,* sub-family *Cetoninæ,* Eds.]

XXXIV.—THE EFFECTS OF THE BITE OF A CENTIPEDE (*SCOLOPENDRA SP.*).

While sitting one evening on the Worli seaface I was suddenly aware of a severe stinging sensation just near my armpit. Beyond rubbing the spot I did not pay much attention to it for a few moments, but shortly the irritation became more severe and I felt as though I had been stung by a Jelly-fish. The irritation spread from the spot at which I first felt it, over part of the arm and a small portion of the chest. This led me to investigate matters further. On commencing operations I discovered a centipede leak out of the sleeve of my shirt—here was the source of the trouble. On examination of the spot I found two distinct punctures about a quarter of an inch apart, not unlike the punctures made by the fangs of a poisonous snake, where the beast had bitten me. The seat of each puncture was red. The redness continued for about four days at these points. At the time when I received the bite, a slight local inflammation spread round the punctures themselves for a couple of inches or a little more. By the next morning this inflammation had disappeared. The stinging sensation lasted for about half an hour and then gradually died down; it was by no means beyond endurance. Nothing was applied. No pain was experienced in the sympathetic glands under the arm.

C. McCANN.

XXXV.—A CENTIPEDE AFTER ITS MOULT (*SCOLOPENDRA SP.*).

One day one of the assistants brought in a centipede which had just cast its skin. The species, which under ordinary circumstances is a metallic bluish black, was at this time quite pink. The whole animal was quite limp and could be handled freely, though it showed its resentment. It did not attempt to bite and was unable to walk away—all the parts being quite soft. Even the two front feet which are converted into the 'fangs' were quite soft and useless for their purpose. This shows that the creature at this time is quite helpless and unable to defend itself. In a few hours it slowly regained its activity and was able to move about. Up to this time the legs were too weak to carry the body.

BOMBAY NATURAL HISTORY SOCIETY,
6, APOLLO STREET, BOMBAY,
September 15, 1930.

C. McCANN.

XXXVI.—SOME NOTES ON THE FLOWERING OF BAMBOOS.

In April I received the following letter from Mr. G. C. Robinson, Dy. Conservator of Forests, in North Malabar.

'I have been reading your articles in the *Bombay Nat. Hist. Soc. Journal* on Bamboo flowering. The following details may be of interest to you regarding the Nilambur forests of South Malabar, which I believe are those probably referred to by Brandis when he makes his very precise assertion as to years of flowering in S. Malabar.

Mr. A. Wimbush, I.F.S., now Conservator of Forests, who was District Forest Officer, Nilambur, for about four years from 1910, states in the Madras Forest Pocket Book, that flowering (of *B. arundinacea*) occurred in Chatomborai Block in 1907. Mr. R. Bourne, I.F.S. (retired), who was D.F.O. 1914-1918, states in his Working Plan for those forests that 'the bamboo (i.e., *B. arundinacea*) in the division commenced to flower sporadically in 1911. In recent years it has flowered in Edacode in 1911, in Chatomborai in 1911 and 1912, in New Amarampalam, Nellicutta, and Karumpoya from 1912 up to the present time (i.e., about 1919), and in Pukode and Kanakuth in 1918. It has hardly flowered in Paunengode, very little in Walluvasseri, and very little along the banks of the main river.'

'I succeeded Mr. Bourne in 1919 (January) (after three years off and on, in the Division) and had five years experience of the Division up to August 1924, during which period intensive flowering occurred in Walluvasseri and Paunengode and sporadic flowering continued in some of the other parts mentioned above, but along the river banks it had hardly occurred at all by the time I left.

'Mr. R. S. Browne, I.F.S., has recently prepared a revised Working Plan, after several years experience in the Division. In it he makes no mention of any further flowering.

'The general impression to be obtained from the above is, I think, that flowering does not occur gregariously in one, or even three years, over a vast area. I believe many of the occasions recorded in your article may probably have been isolated visits by the person who records them, and who is ignorant of what has happened in years before and after his visit.

'You quote Troup as reporting *B. arundinacea* as beginning to flower in the Wynaad (my present division) in 1912 and this spreading southwards to Kollegal and Coimbatore where it ended in 1915. I have been for five years in Coorg, the division immediately north of Wynaad, 1925-1930. Flowering was occurring in the plateau parts in 1916, 1917, 1918 I have been told, and has been and is still occurring in the low country parts of Coorg during and since my period of service there, working slowly northwards I would say.

'Incidentally as regards *Ochlandra* I am interested to see you say it is one of those that flower but do not die. I have only once in fifteen years service seen any *Ochlandra* in flower (either *rheedii* or *travancorica* I believe) and that was about fifteen months ago in Coorg, at an elevation about 4,000 or 4,500 ft. The jungle people told me it would flower over wide areas in 1930 or 1931. What I saw was a small patch. I arranged for collections of flowers and seed, to be sent to Parker, as my subordinates told me there are six species or more.

'Lastly, the compound of my present bungalow was formed about 1885 as a Botanical garden. Exotic bamboos (believed to be either *Dendrocalamus giganteus* or *Brandisii*) were introduced at about that date, and there is reason to believe they never have flowered yet. I am quoting from a Working Plan now in the Press, prepared by J. Coode, I.C.S. These bamboos are of great height and girth.'

In September 1930 I received a note from Mr. E. Little of the Government House Gardens:

'*Dentrocalamus giganteus* has just flowered and seeded in the Empress Gardens, Poona. On the parent plant almost all the stems flowered and are now dead. I think there are two stems still with leaves. On one side of the plant the rhizomes are sending up new shoots. Another plant separated from the parent plant many years ago produced some flowers on some of the stems but quite a number of stems are in full leaf now and will not die this year I think.'

E. BLATTER.

XXXVII.—ON THE FLOWERING OF BAMBOOS.

I have been reading with great interest Father Blatter's articles on the *Flowering of Bamboos* especially as regards the connection between the flowering of the bamboos and famine.

In the Assam Hills, at any rate, there is a very close connection between the flowering of the bamboos and famine. In the Lushai Hills District, both Lushais and Lakhers recognize that Bamboos flower at regular intervals, seed and die down and that after the seeding of the bamboos, famine invariably follows, the cause of the famine being millions of rats which appear suddenly and devour both the standing crops and the grain in the granaries. Having devoured all they can find, the rats die presumably of starvation. Both Lushais and Lakhers when they want to fix an approximate date, say, 'it happened before or after the last famine or the last famine but one', as the case may be. Lushais recognize two kinds of famine, the *Maotam* which occurs after the flowering of *Melocanna bambusoides* (*Mao*) and the *thingtam* which occurs after the flowering of the Ronal (*Dendrocalamus Hookeri*) and the Rothing (*Bambusa tulda* Roxb.). The *Maotam* is much more severe than the *thingtan,* presumably because *Melocanna bambusoides* is the commonest bamboo in the hills and seems all to flower at one time, while *Dendrocalamus Hookeri* and *Bambua tulda* Roxb. seem to flower over a period of four or five years and induce severe scarcity rather than famine. In each case the famine is caused by a plague of rats which devour the crops. Lakhers only recognize one famine, the *Maotam* or, as they call it, the *Mawta.* They say that the period between two *Mawta's* is about fifty years and that during this interval a bamboo called *rongal* in Lushai and *rangia* in Lakher (*Cephalostachyum capitatum*) flowers. The seeding of (*Cephalostachyum capitatum*), is called by the Lakhers *lanongaten.* The seed of this bamboo does not seem to induce a plague of rats and the period of its seeding is generally a period of very good crops. Both tribes have tales of monstrous rats which appear during a famine, some being half rat and half caterpillar and some half rat and half jungle-fowl. A reference to the rat famine which occurred in 1864 will be found at p. 38 of Lewin's *Wild Races of South*

Eastern India. However the fact that in the Assam Hills famines after flowering of the bamboos are caused by a plague of rats is incontrovertible and well established.

The last *Maotam* in the Lushai Hills occurred in 1911-12 after the flowering of the *Melocanna bambusoides.* The country was absolutely devastated by millions of rats which swept right over the District devouring everything that lay in their path. I was not in the Lushai Hills at this time but Government had to give out large sums in loans as the people were absolutely destitute and it fell to me to collect the amounts due in repayment of the loan some years later. The *Maotam* before that, was, I think, in 1864 or thereabouts while the Lushai Hills were still unadministered and hundreds of Lushais are said to have died of famine. A very old Lakher Chief who was said to have been between 100 and 120 when he died, is said to have passed through three *Maotams* due to the flowering of *Melocanna bambusoides* and two periods of prosperity (*lanongaten*) during which *Cephalostachyum capitatum* flowered.

During the years 1924-28, when I was in the Lushai Hills, *Dendrocalamus Hookeri* and *Bambusa tulda* were both flowering all over the District throughout this period. Rats increased greatly and in spite of large numbers being killed, there was serious scarcity in many villages in 1929. This scarcity, however, did not approach in severity the famine of 1911-12, probably because the flowering taking place over a period of years instead of at one fell swoop, rats did not increase so suddenly as in 1911-12.

In January 1926 I found *Cephalostachyum capitatum* flowering near Sairep in the Lunglet district and curiously enough the Lakher villages in the south-east of the district were hardly at all affected by the scarcity in 1929 which was felt in other parts of the district.

In the Garo Hills in 1920-21 there was scarcity in part of the District owing to a plague of rats ensuing after the flowering of some bamboo, of what species I do not know, as at the time I did not enquire. Last cold weather 1929-30 I found the following kinds of bamboo flowering sporadically in the Garo hills :—

	Garo name	*Lushai name.*
(1) *Bambusa tulda ?*	Wajarah.	Rothing.
(2) *Melocanna bambusoides.*	Watre.	Mao.
(3) ?	Wanok.	Phulrua.

I have sent specimens for identification and if they are of any interest I can let you know what they are, in due course. All three were only flowering sporadically and in different parts of the district. When I left the district in April there were no signs of any impending famine and no noticeable increase in the number of rats. Probably rats increase and cause famine only when bamboos flower gregariously over large areas as occurred in the Lushai hills in 1910-11 and in or about 1864.

Though I have only personal experience of the Lushai hills, and Garo hill districts, I think I am correct in saying that famines due to the depredations of rats follow on the flowering of the bamboos in other Assam hill districts. If I recollect rightly there was such a famine in the North Cachar hills in 1914 or thereabouts and I believe, though I cannot vouch for it, that similar famines occur in parts of the Naga hills.

When the bamboos flower, Lushais carefully avoid *jhuming* the areas in which flowering has taken place as, if these areas are *jhumed,* the young bamboo seedlings get destroyed and the bamboos die out.

It would be of great interest to know the exact connection between the flowering of the bamboo and the increase in the rat population. The flowering of *Melocanna bambusoides* appears to induce a vast and comparatively sudden increase, while during the flowering period of *Dendrocalamus Hookeri* and *Bambusa tulda* the increase appears to be more gradual. From 1924-1928 I ordered all villages to kill rats regularly and to make monthly returns of the numbers killed. I have not got the figures here, but they showed that there was actually a very large increase in the number of rats throughout the district. The Lushai theory is that a diet of Bamboo seeds makes the rats phenomenally prolific and that having disposed of the bamboo seeds they then attack the crops. Is this possible? Another theory is that on the seeding of the bamboo, rats swarm to the area where the seeding has taken place, from all over the hills. If this is so, how do the rats get to know about it? In 1911-12, I have been told by both Lushais and Europeans that rats were going about over the hills in serried masses. How did they increase as quickly they appear to have done?

If the connection between the flowering of the bamboo and the increase in the rat population can be solved and a means of preventing an increase in rats devised, a great benefit will be conferred on many hill tribes.

12, Howell Road,
Exeter, England,
October 8, 1930.

N. E. PARRY,
I.C.S.

XXXVIII.—THE FERN-PALM.

(*With a photo*)

The male plant of *Cycas circinalis,* Linn. was in flower in the Victoria Gardens. The flower in the male plant resembles a cone and is situated at the apex of the stem, surrounded by the leaves. It is one of the handsomest specimens in the Gardens particularly when in flower, which appeared during the monsoon from July to September.

Cycas circinalis or Fern-Palm is a palm-like tree with cylindrical trunk and a crown of glossy, fern-like, stiff but gracefully curved pinnate leaves. It is indigenous to the Malabar Country, and South India, where it attains a great size, the trunk being 10 to 15 ft. bearing a noble crown of leaves 8 to 12 ft. in length. Most of the species of *Cycas* are arborescent, having a trunk marked with rings of growth and with scars of fallen petioles. The trunk is usually simple and columnar and is elongated by a terminal bud. The pinnate leaves form a beautiful terminal crown like that of a Palm or Tree Fern.

Cycas are among the most ornamental plants of tropical and subtropical gardens. They are often designated 'Sago palms' although they have nothing in common with a palm except the general habit of growth. The beautiful, glossy leaves are used for decoration.

The *Cycadaceæ* are of very great interest to the Botanist, because they occupy a place intermediate between *Phanerogams* (the flowering plants) and the *Cryptogams,* viz., ferns, mosses, etc.

There are various species of *Cycas* cultivated in the garden, e.g., *Cycas Rumphii,* Miq. another indigenous species; *Cycas medica,* R. Br. is an introduction from Australia; *Cycas revoluta,* Thumb. is a native of China and Japan and *Cycas siamensis,* Miq. from Burma, Siam and Cochin China.

The cone of the *Cycas circinalis* was sent to the Herbarium of the Section of Botany of the Royal Institute of Science, Bombay.

Municipal Gardens,
Bombay,
October, 1930

D. S. LAUD,
G.B.V.C., F.R.H.S., F.Z.S.,
Superintendent.

XXXIX.—AN ABNORMAL FRUIT OF *DIPTEROCARPUS TUBERCULATUS,* ROXB.

The normal fruit has two wings and the fruiting tube is produced into five sharp knobs. The abnormal carried three wings of the same size with six knobs on the pericarp. The abnormal fruit was 1·68 grams heavier than the normal one. It was longer than the ordinary fruit by 4·0 mm. and 2·5 mm. along the transverse and longitudinal axes respectively.

The material was collected from Prome Road, Rangoon. Out of fifty specimens, three were abnormal. The Burmese name for the tree is *Eng.*

July 2, 1930.

L. P. KHANNA, M.SC., F.I.S.,
Rangoon University, Rangoon.

PROCEEDINGS OF THE MEETING HELD ON 27TH NOVEMBER 1930.

A meeting of the Members of the Bombay Natural History Society and their friends was held at the Prince of Wales Museum on Thursday, the 27th November at 6 p. m. Mr. H. A. W. Brent presided.

The Honorary Secretary, Sir Reginald Spence, Kt., announced the election of the following 15 new members since the last meeting held on the 28th August 1930 :—

The Honorary Secretary, Northern Shan States Club, Lashio, Burma ; Mr. Oscar Keip, Bombay ; Mr. Robert Popper, Bombay ; Mr. Peter P. Pazze, Bombay ; Mr. F. H. Cole, Sukkur, Sind ; Mr. E. J. Van Ingen, Ootacamund ; Mr. A.V. Oldfield, Bombay; Major C. Davenport, O.B.E., R.A.V.C., Bombay; Mr. C.B. Rubie, Karachi ; Capt. G.N. de la Farque, Delhi ; Mr. D. Davidson, Lampang, Siam ; Capt. D. R. Smith, Mount Abu ; Capt. Krishna Lal, Indore ; Mr. G. H. Emerson, I.C.S., Hoshiarpur, Punjab ; and Mrs. M. Carrington Turner, Almora, U.P.

Sir Reginald Spence, Honorary Secretary of the Society, in opening the proceedings referred to the nomination by H. E. the Governor of Mr. Prater, the Society's Curator to a seat on the Legislative Council. He was of opinion that it was a tribute to the good work Mr. Prater had done and he felt that his appointment to the Council was also in the interests of the Society. He asked those present to join with him in congratulating Mr. Prater.

Mr. Prater then gave his lecture on 'Communism in Nature' as expressed in the social life of animals. He developed his theme in an outline of the life of the Termite—a class of insects popularly referred to as White Ants. Termites are no more ants than a beetle is a butterfly. They are insects of a totally different order. A habit, common in most termites, of feeding on wood and of living in its cavities explains many features in the social life of these insects. It is probably responsible for their way of feeding each other on regurgitated food, their loss of colour, their loss of eyesight and the thinness of their skins. They look almost like grubs. Their weak and defenceless character has led to the development of various contrivances for encountering their enemies. The hereditary foes of the Termites are the Ants. Between them there has been waged a war which has continued unabated for millions of years. The whole system of nest architecture from its origin in rude exposed shelters, in open galleries in the wood or in borings in the ground to the elaborate mounds in which the higher tribes of termites live to-day has been gradually evolved as a direct response to the need of protecting the termite communities from the attacks of their ancient enemies the ants. Perhaps their crowning achievement was the cultivation of mushroom gardens within their walled fortresses. These gardens take the form of brown, spongy masses which are enclosed in specially prepared chambers within their mounds. The gardens supply food to the young termites and also to the parents of the colony. The lecturer referred to the division of labour in these termite colonies. In each colony of higher termites it was possible to find 5 types of individuals —each fundamentally different in structure, each incapable of performing any function but its own. These were the Queen and King—the parents of the colony, their children were divided into two castes—workers and soldiers. At certain seasons winged individuals were produced whose function was to found new colonies. The king and queen did not govern the colony. They were kept prisoners in a cell where they were fed by the workers and guarded by their soldier children. They had one duty, the production and fertilization of millions of eggs. The workers were children of the king and queen who did not complete their development. They were blind in most species; they never grew wings and their reproductive organs were undeveloped. They were sterile. They had but one instinct—to work for the good of the community They provided food, looked after the queen and her young. They built, enlarged and repaired the nest. The defence of the community was the duty of the soldiers. They carried powerful jaws and other weapons for their task .

They provided guards, organized the defence in case of attack and gave their lives instinctively in the defence of the community. Like the workers, they were blind, like them sexless ; war and not love was their destiny.

Winged termites representing fully developed and fully sexed individuals were produced at certain seasons. Their duty was the foundation of new colonies. This was effected by a swarming flight called the marriage flight. The young males and females leave the nest in a body and the few that survive the general massacre that ensues—the majority of them fall victims to a host of birds, reptiles and other creatures which prey upon them—these live to found new colonies.

The lecturer then described the process of development of a new colony and the way in which the termite's mound was built.

In drawing his conclusions Mr. Prater dwelt on the frightful sacrifice Nature demanded from the individuals in an insect society in order that the race may survive. This was taxation in its most terrible form. She condemned the majority of the population to sterility, denied them the power of mating and reproduction—Those whom she endowed with the privilege—the majority of these she condemned to a premature death. And those that survived—they were condemned to life-long imprisonment within the confines of a narrow cell, They lost their liberty, they were unable even to fend for themselves, they had but one duty—ceaseless child-birth. And what of their children—the toiling millions, deprived of the elementary privileges of the creature, sexless and blind, they were condemned to a life of incessant drudgery and toil, for which they received their share of food. This and nothing more. In the social life of these insects the principles of communism were developed to the letter. Each individual carries out its appointed task and receives its alloted share of the common produce. There was no friction, no dissension, no differentiated scale of wages. All, including the King and Queen, were automatons—cogs in the communal machine of which every individual was a mechanical unit.

As insects were deprived of reasoning power, of enterprise and ambition, the system of government suited their needs perfectly. Could it be applied to Modern Man ? Could we be reduced to the deadening level of automats ? Brains would always differentiate and even in the most ideal of Communistic States there would be individuals sharp enough to get their extra percentage. The system could only be applied by the subversion of one of Nature's universal laws. The survival of the fittest. The set order of Nature precluded the possibility of things which are unequal being reduced to the level of the least common denominator.

The meeting closed with a vote of thanks to the lecturer.

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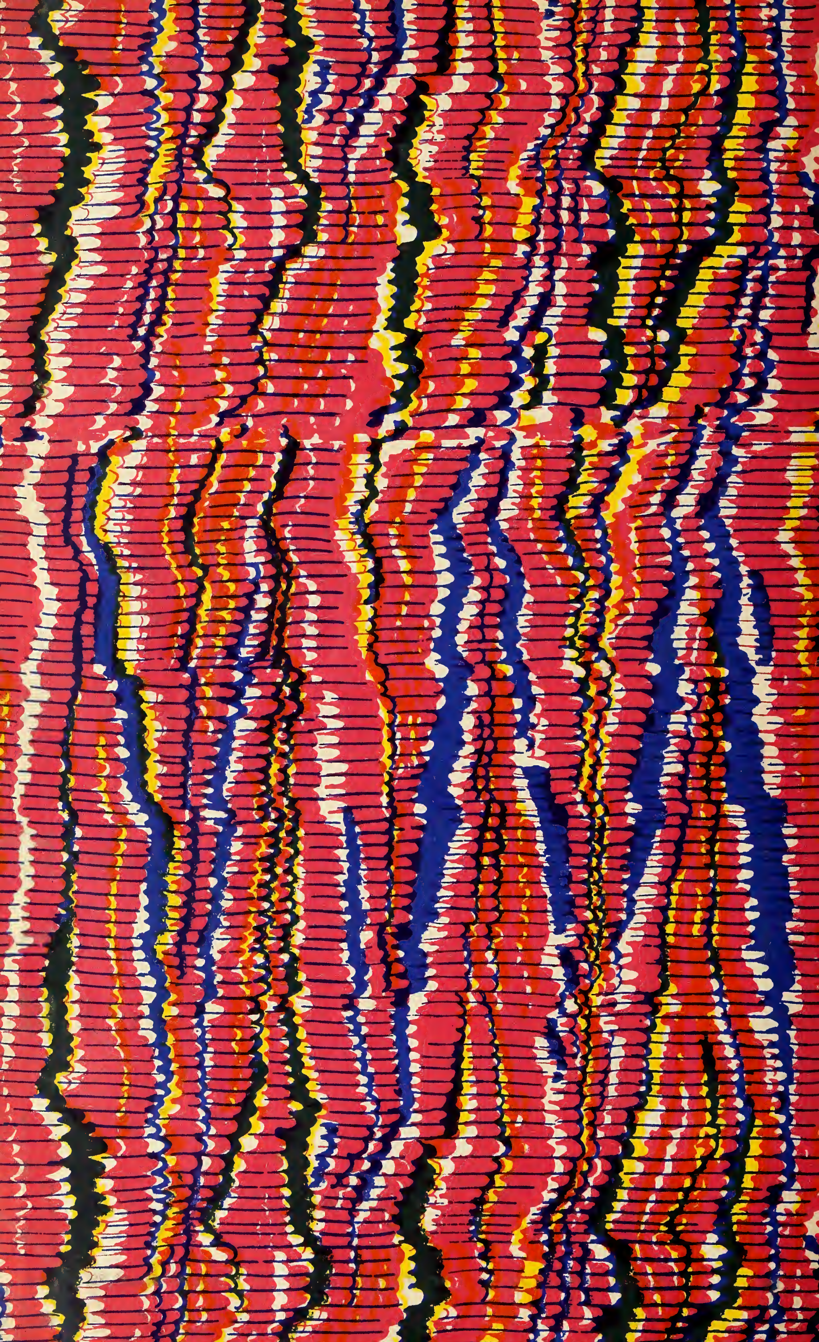

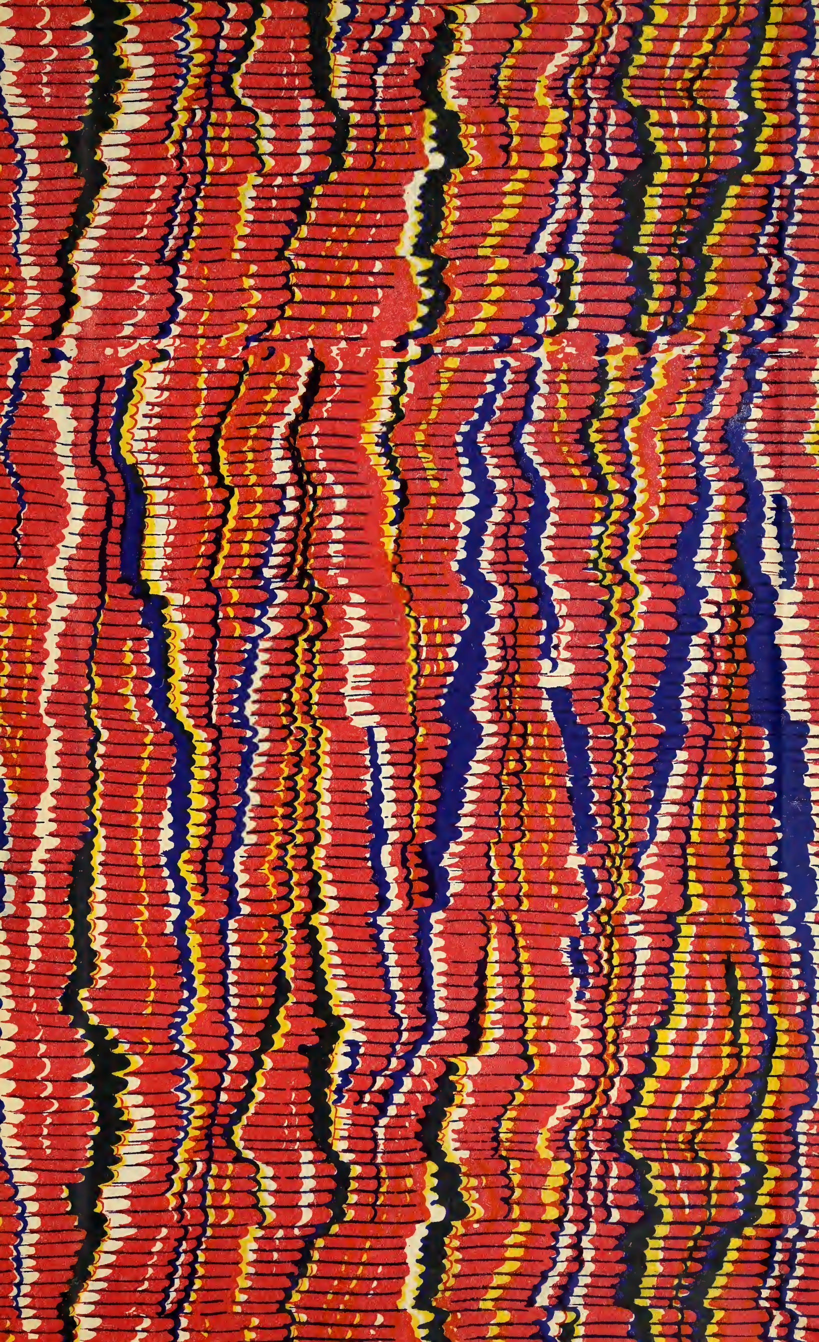

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